July 15, 1957 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

M-W Wing Eases Sweep Problems

•

Dectra Begins Atlantic Trial

NACA M-Wing Test Vehicle

engineers agree

Not on how to mix a Martini –
nor necessarily on how to build
a missile platform –
but every day,
throughout the industry,
Engineers agree
on Wiggins Connectors.

Wiggins

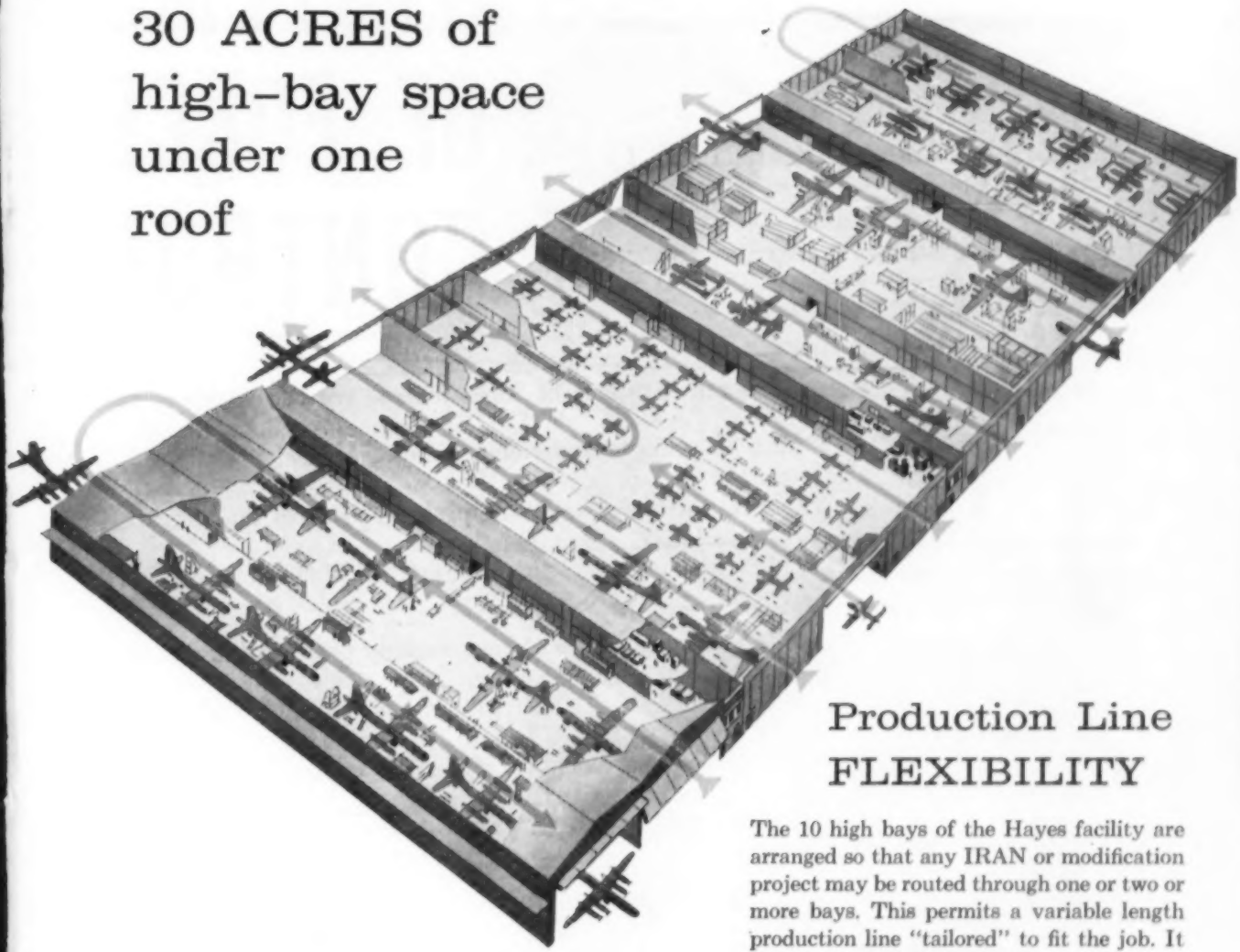
The authority on connectors
Engineered for Reliability

E. B. Wiggins Oil Tool Company, Inc.
3424 East Olympic Blvd., Los Angeles 23, Calif.

Aircraft IRAN and Modification on a

Production Line Basis

30 ACRES of high-bay space under one roof



Production Line FLEXIBILITY

The 10 high bays of the Hayes facility are arranged so that any IRAN or modification project may be routed through one or two or more bays. This permits a variable length production line "tailored" to fit the job. It also precludes all possibility of one project getting in the way of another and complicating or slowing down production.

This "bowling alley" floor plan of the Hayes facility plus accurate cost control, high standards of workmanship and quality materials explains Hayes outstanding record of service and on-time-delivery.

TO SCIENTISTS and ENGINEERS

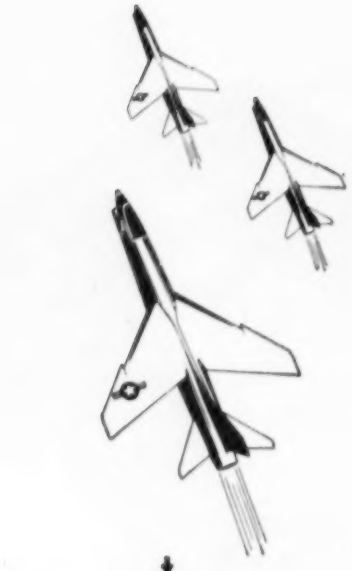
With over 8,000 employees, Hayes is a competitive industrial facility for modification and maintenance of aircraft, including guided missile work and engineering design of all types. Opportunities are open for scientists, experienced aircraft design engineers, and graduate students in engineering. Write Personnel Department.

ENGINEERS • DESIGNERS • MANUFACTURERS

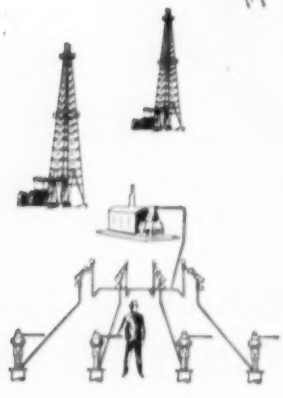
Hayes
AIRCRAFT CORPORATION
BIRMINGHAM, ALABAMA

SARGENT

SYSTEMS OF FORCE CONTROL



HYDRAULIC
PNEUMATIC
MECHANICAL
ELECTRONIC



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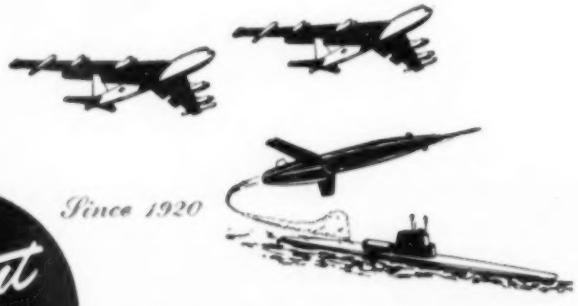
— U.S. Supreme Court



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Sargent offers exceptional opportunities to engineers interested in design, development, qualification testing and manufacture of advanced forced control systems. Send your resume immediately (in confidence) to Chief Engineer.

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AVIATION CALENDAR

July 28—Third Annual Jaycee Air Fair, sponsored by Portland (Oregon) and Junior Chamber of Commerce, Portland International Airport.

July 31-Aug. 4—Eleventh Annual National Convention, Air Force Assn., and Airpower Panorama, Sheraton-Park and Shoreham Hotels, Washington, D. C.

Aug. 1-2—Second Annual Exiborama and First Annual National Photo Instrumentation Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles.

Aug. 5-10—National Naval Aviation Meeting, Institute of Aeronautical Sciences, U. S. Grant Hotel, San Diego, Calif.

Aug. 10-11—Midget Airplane Races, Oshkosh, Wis.

Aug. 17—Open house for pilots and public, Piper Aircraft Corp., Lock Haven, Pa.

Aug. 20-22—Bendix-Scintilla International Ignition Conference, Sidney, N. Y.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Aug. 26-28—Gas Dynamics Symposium Transport Properties in Gases at High Temperatures and Pressures, Technological Institute, Northwestern University, Evanston, Ill.

Aug. 31-Sept. 1—Midget Airplane Races, Ft. Wayne, Ind.

Sept. 1-15—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkestone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-14—11th General Assembly, International Union of Geodesy and Geophysics, in conjunction with International Geophysical Year, University of Toronto, Canada.

Sept. 8-13—Second Annual Course on Investment Castings, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 9-13—Annual General Meeting, Inter-

(Continued on page 6)

AVIATION WEEK • JULY 15, 1957

Vol. 67, No. 2

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AVIATION CALENDAR

(*Continued from page 5*)

national Air Transport Assn., Madrid.

Sept. 9-13—Twelfth Annual Instrument-Automation Conference & Exhibit, Cleveland Auditorium, Cleveland, Ohio.

Sept. 13—Third Pacific Area National Meeting, American Society for Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.

Sept. 15—1957 Garden Party and Flying Display, Royal Aeronautical Society, Wisley Aerodrome, Weybridge, England.

Sept. 26-27—Fifth Michigan Aeronautics Conference, jointly sponsored by University of Michigan Transportation Institute, Western Michigan University, and The Aero Club of Michigan, Alpena, Mich.

Oct. 1-5—National Aeronautics Meeting, Aircraft Production Forum & Aircraft Engineering Display, Hotel Ambassador, Los Angeles.

Oct. 2-4—Tenth Annual Meeting and forum, National Business Aircraft Assn., Cosmopolitan Hotel, Denver, Colo.

Oct. 6-12—Eighth International Astronautical Congress, Barcelona, Spain; Registrar: Agrupacion Astronautica Espanola, Arda., Generalissimo Franco, 377, Barcelona.

Oct. 7-9—13th Annual National Electronics Conference, Chicago, Ill.

Oct. 7-10—Triennial Inspection, Lewis Flight Propulsion Laboratory, Cleveland.

Oct. 7-12—Eighth Annual Congress, International Astronautical Federation, Barcelona, Spain. For details write: IAF, 35 Lowell Rd., Concord, Mass.

Oct. 9-11—National Fall Convention, Society for Experimental Stress Analysis, El Cortes Hotel, San Diego, Calif.

Oct. 10-11—Eighth Annual National Noise Abatement Symposium, Sherman Hotel, Chicago, Ill.

Oct. 21-22—Canadian Aeronautical Institute-Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

Oct. 21-23—Conference on new developments in the field of power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

Oct. 24-25—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 28-31—Second Winter Meeting, American Nuclear Society, Henry Hudson Hotel, N. Y.

Oct. 28-29—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 28-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

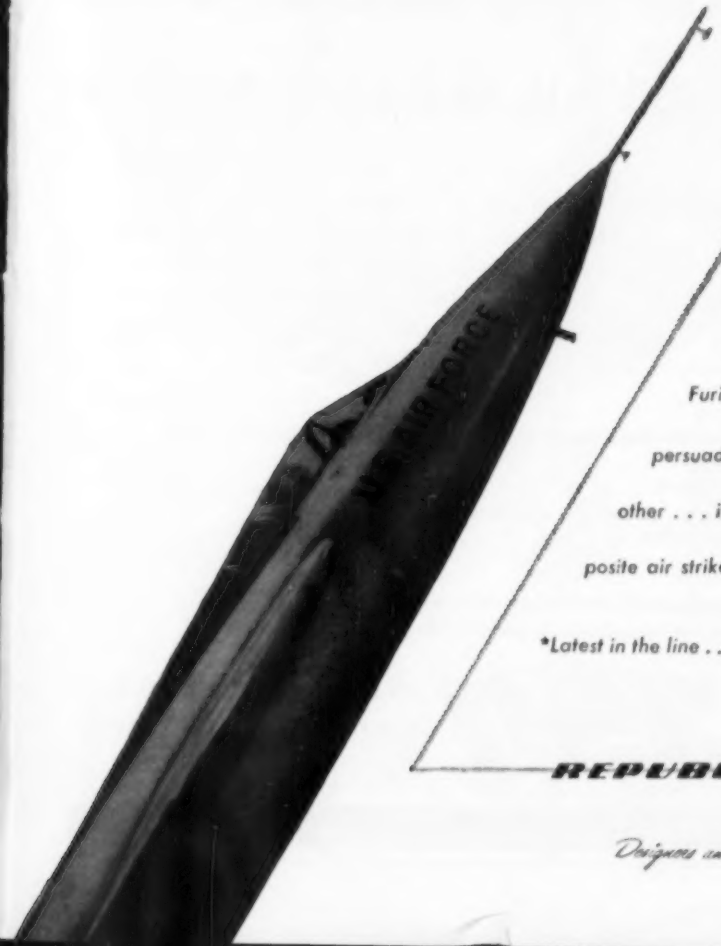
Oct. 28-31—National Industrial Packaging & Handling Exposition, Atlantic City, Convention Hall, N. J.

Nov. 5-7—Joint Military-Industry Guided Missile Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu, Calif.

Nov. 6-8—Third Annual Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y.

Nov. 18-29—International Air Transport Assn. Technical Conference, Miami, Fla.

NOW YOU SEE IT · · NOW YOU DON'T



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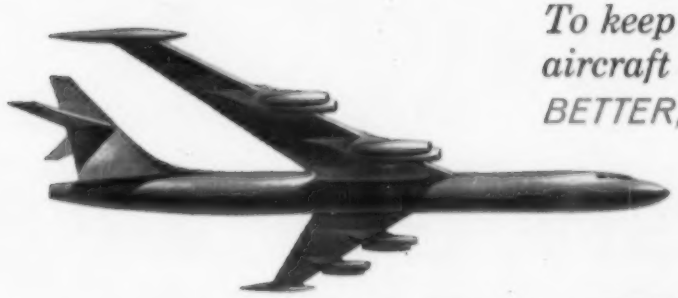

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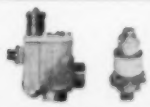

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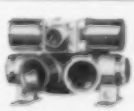

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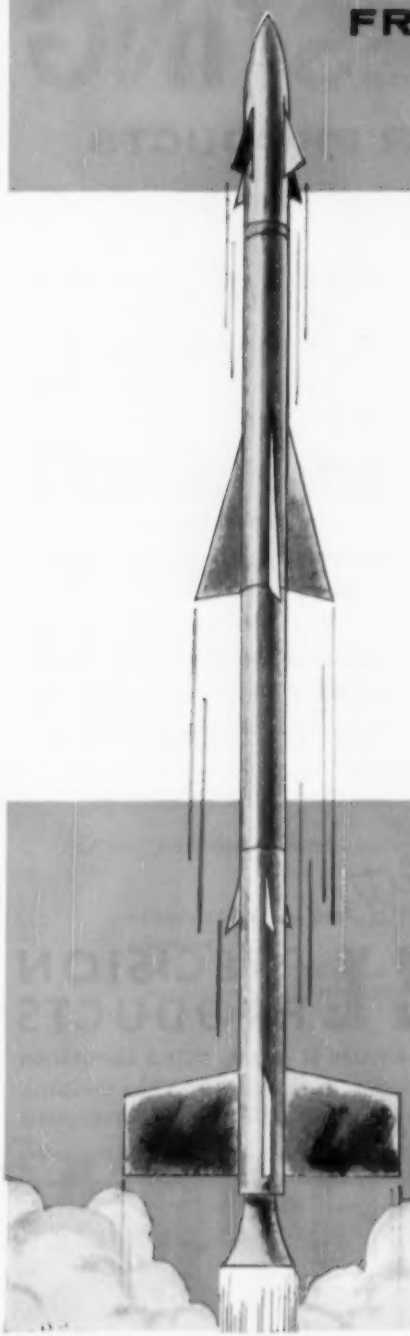

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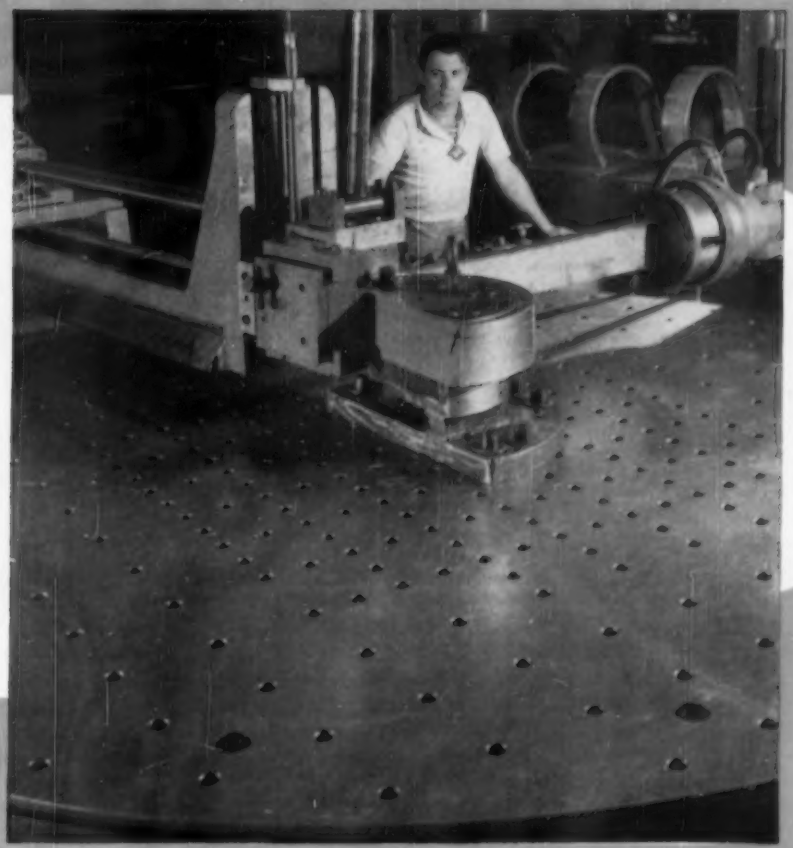

JET DIVISION

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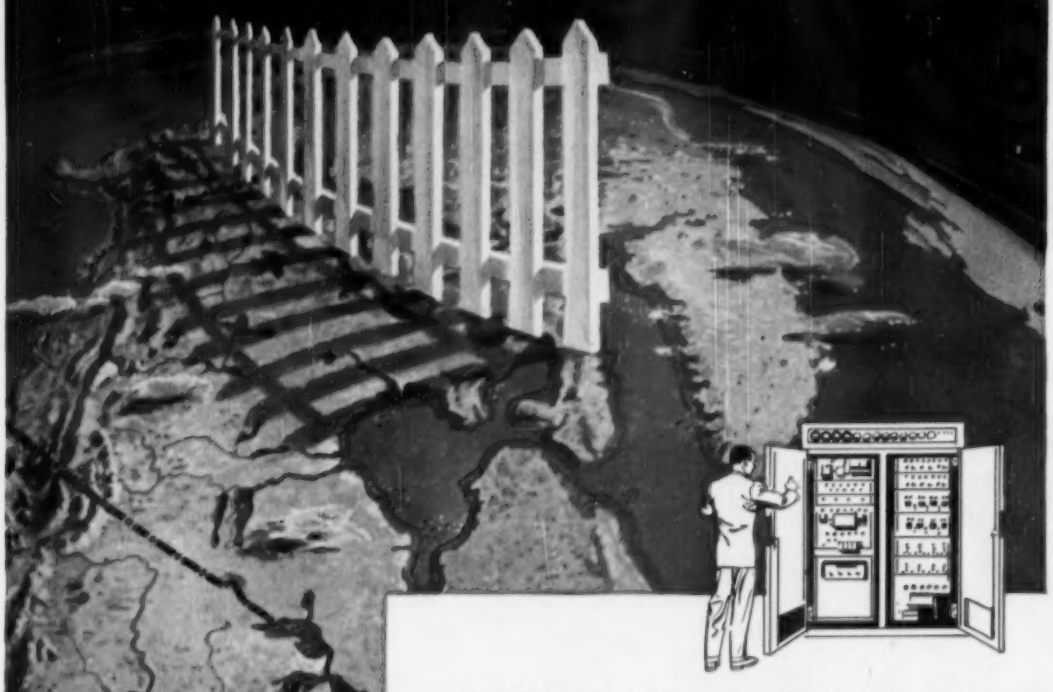
MOTOROLA RADAR PICKETS IN THE "DEW-LINE" FENCE



Stretching 3,000 miles across the Arctic, special Motorola radar systems stand alert, ready to sound a warning at the first indication of an air attack over the polar cap.

The urgency of this distant early warning system called for a "crash" program for both development and production. Working in turn with the Lincoln Laboratories at M.I.T., Bell Telephone Laboratories, and the Western Electric Company, Inc., Motorola engineers came through with radar systems for the complete line within a 14-month period.

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Radar

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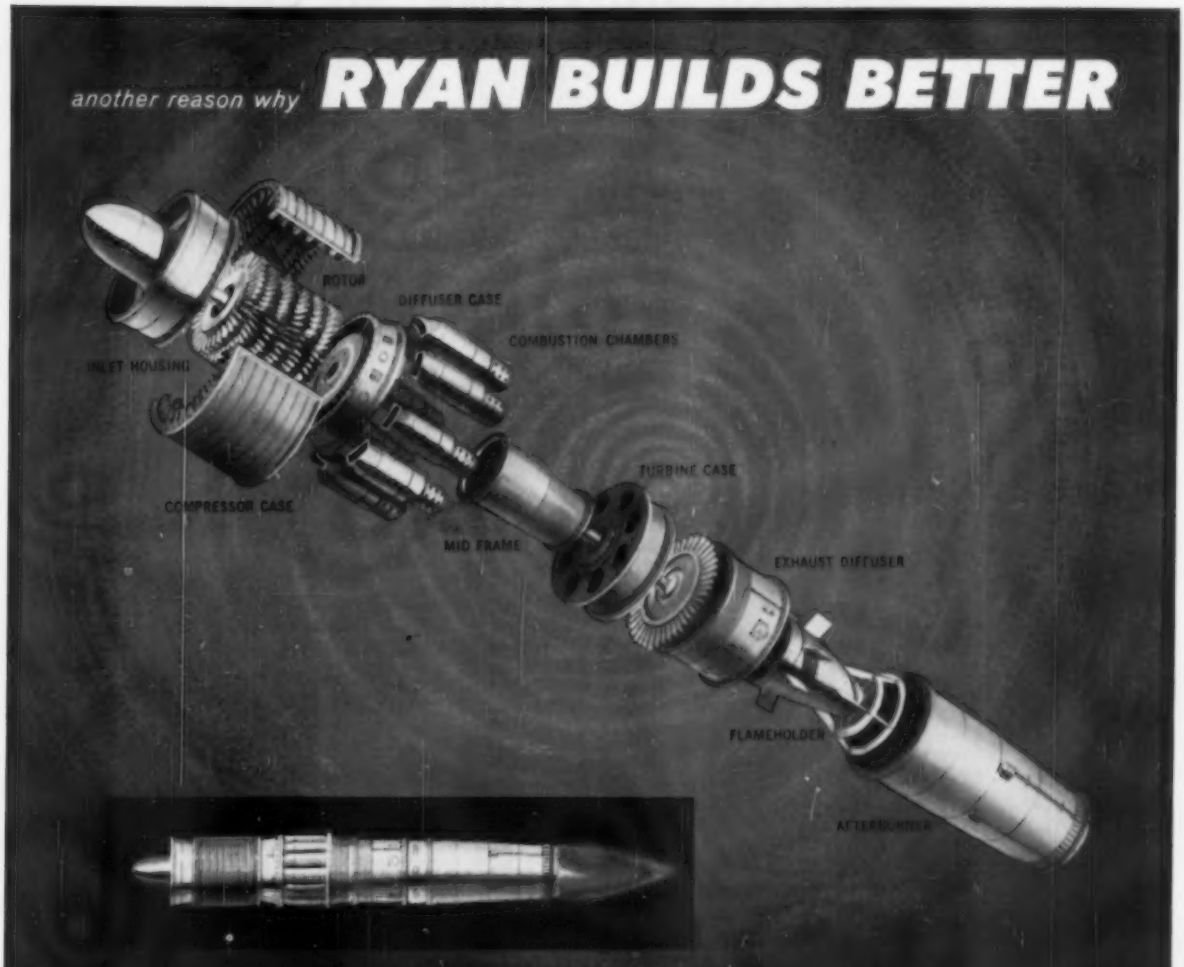

HOT PARTS TO WITHSTAND A SUPERSONIC HEAT WAVE

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EDISON MINIATURE -- HI-TEMP

servo systems and components

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Precision production and rigid quality control inspection have made these "customized" components possible. In addition to these special units, Edison also manufactures an extensive line of standard servo motor and servo motor-generator combinations from size 8 - up, a quality group of synchros, and custom-engineered magnetic heads for flight and ground-based analog computers.

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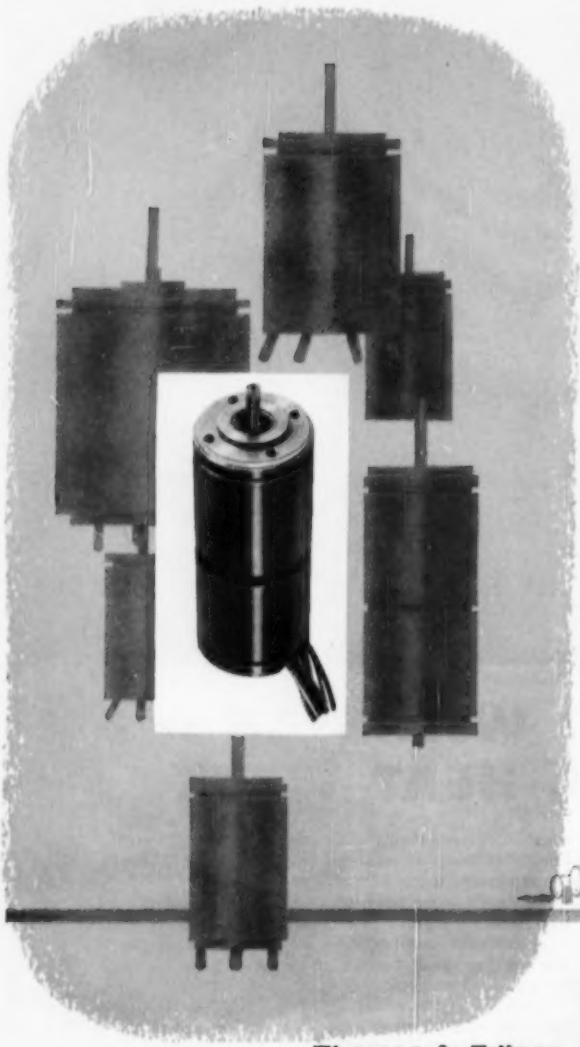
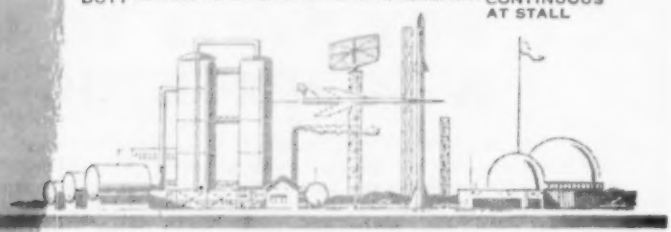


EDISON SERVO MOTOR DAMPING GENERATOR

TYPE OF MOTOR	TWO PHASE SERVO MOTOR-DAMPING GENERATOR
NO LOAD SPEED (MIN. RPM)	5800
STALLED TORQUE (MIN. OZ. IN.)	.60
POWER INPUT TO MOTOR AT STALL (NOM. WATTS/PHASE)	3.5
SPEED AT MAX. POWER OUTPUT (RPM)	3300
TORQUE AT MAX. POWER OUTPUT (OZ. IN.)	.31
THEORETICAL ACCELERATION AT STALL	34,800 RADIANS/SEC.^{2}
TIME CONSTANT	.019 SEC.
POWER INPUT TO GENERATOR AT STALL (NOM. WATTS)	3.5
OUTPUT VOLTS AT 0 RPM (MAX. RMS)	.019
OUTPUT VOLTS PER 1000 RPM (MIN.)	.5
PHASE SHIFT (MAX.)	10 DEGREES
DUTY	CONTINUOUS AT STALL



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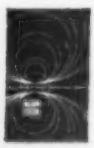

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New ideas in the sky . . . a new concept in airway travel! That's what this sleek, ultra-modern Aero Commander represents. It's fleet, maneuverable, comfortable . . . the ideal way to get there and *get there fast* for the modern business man. And it's Harrison that gets the cooling call on this popular new executive transport. Beating the heat for the most advanced aircraft is a Harrison specialty. It requires engineering skill, production know-how and the research facilities that you'll only find at Harrison. So remember . . . if you have a cooling problem, look to Harrison for the answer.

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORP., LOCKPORT, N. Y.

Lightweight, heavy-duty Harrison oil cooler is in command of heat on the advanced Aero Commander.

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Watch "WIDE, WIDE WORLD" Sundays on NBC-TV

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HARRISON

THE MARK OF QUALITY

BARBER COLMAN

Aircraft Controls

new, high-speed lightweight actuator

actual size
1-3/8" diameter, 4-5/32" length
0.56 lb. weight

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Rotary and linear actuators combining gear reductions, switching, mountings, and other features to meet most applications in their load-speed class. Illustrated below are but a few of the wide range of Barber-Colman standard and custom-designed units.

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LINEAR TYPES

New Barber-Colman PYLC actuator drives 7.5 lb-in. load 95° in less than 200 milliseconds

Here's the new, advanced-design Barber-Colman actuator that is helping solve today's spacesaving and weightsaving problems. Primarily for aircraft and accessory equipment applications, Barber-Colman small, compact, lightweight PYLC actuators can be used as fuel-valve operators, ram air valve operators, optical filter changers, and for other applications where actuators, such as shown above, make ideal replacements for rotary solenoids. Actual tests of this unit indicate a life expectancy of 100,000 cycles. Standard units are rated up to 10 lb-in. with a wide range of speed-torque outputs. Available with split series, permanent magnet, or 400-cycle motor . . . optional radio noise filter . . . smooth, serrated, or special output shaft. Call your nearest Barber-Colman engineering sales office, or write direct for illustrated data sheet F-8017.

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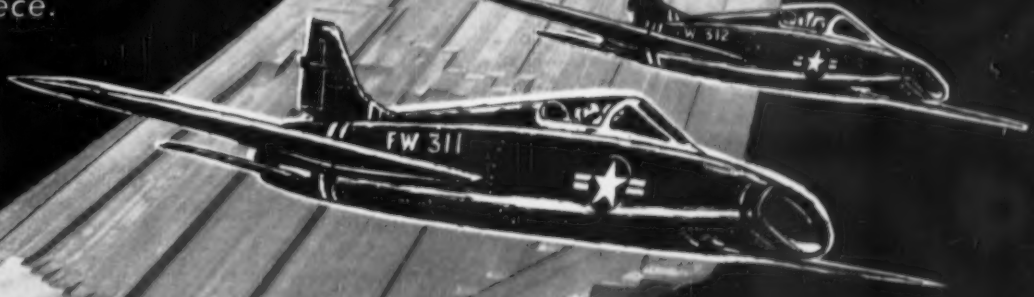
sculpture in motion..

this is the wing it flies on .. modeled in metal .. a modern, machined masterpiece.



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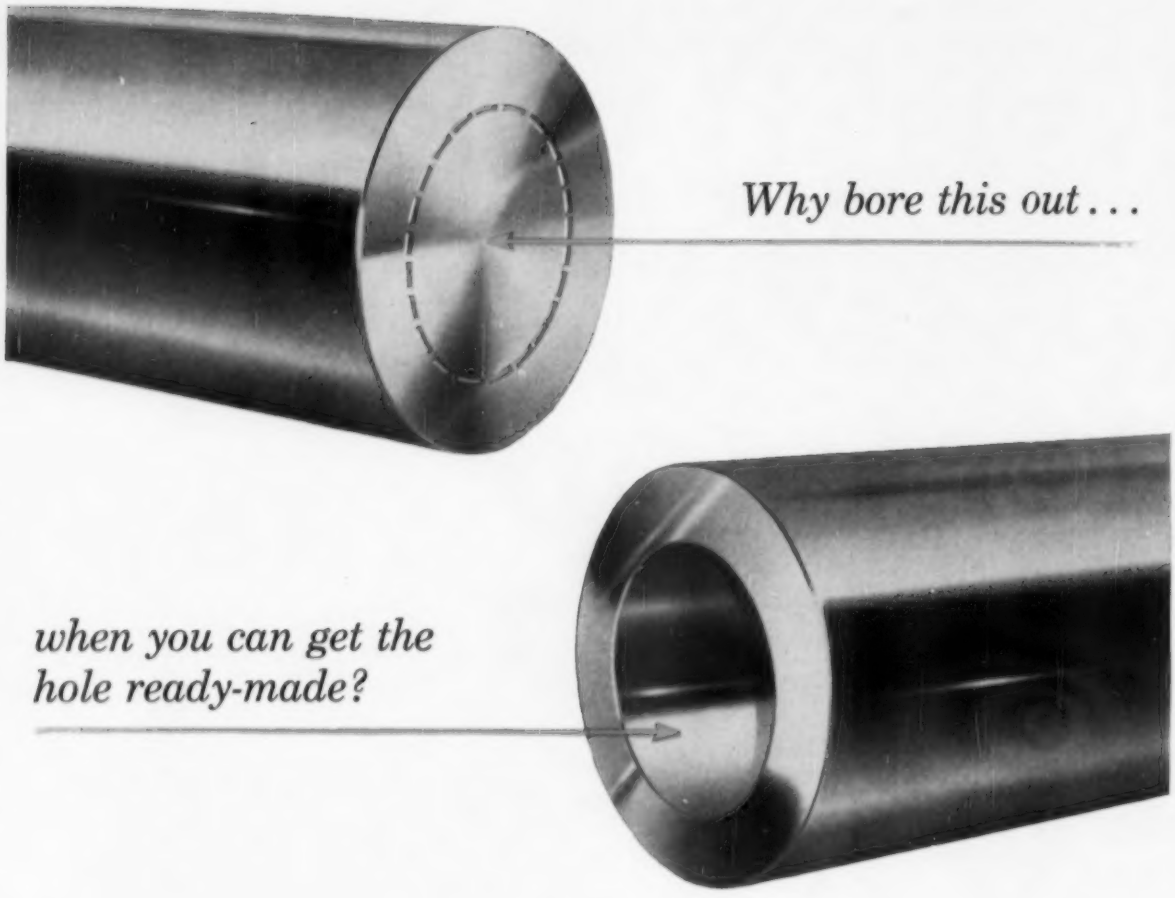

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COVER: Research model with an M wing is being readied for firing at NACA's Wallops Island facility. Booster rocket took the model to Mach .9, sustaining rocket in the fuselage sent it to about Mach 1.4. For detailed story on M and W wing aerodynamics see page 50.

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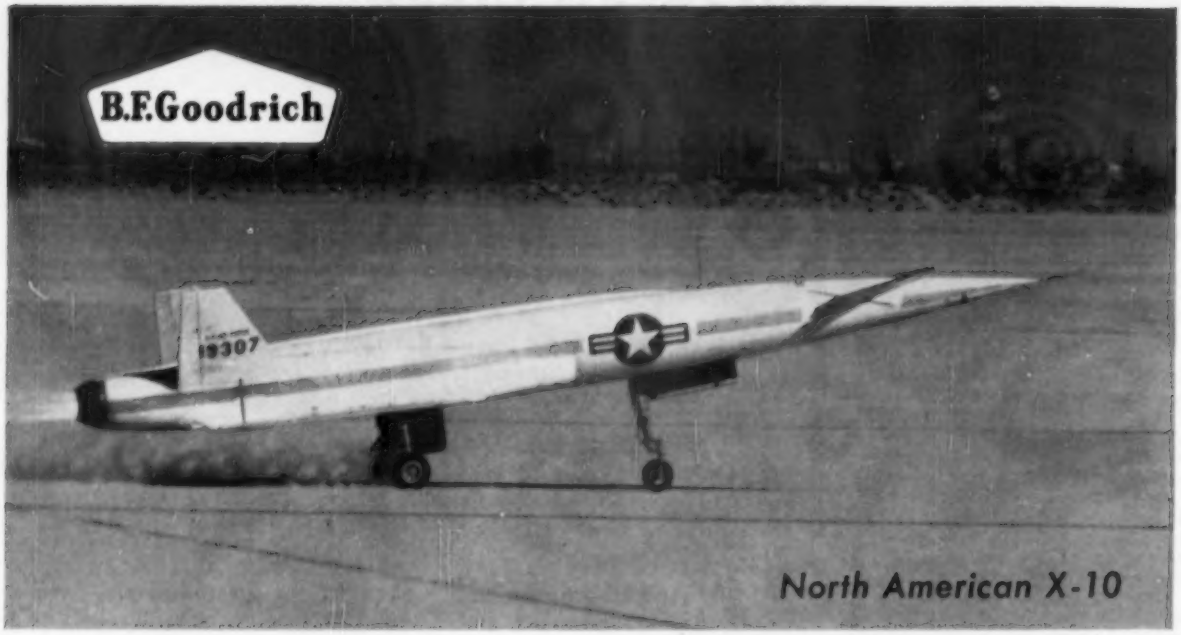

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North American's X-10 plays a vital part in development of the SM-64 Navaho intercontinental supersonic, strategic guided missile. When this unmanned test vehicle screams onto the landing strip, exceptional requirements must be met by landing gear components.

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EDITORIAL

Salute to the Sabre

Every so often, an aircraft comes along with the right performance at the right time to carve itself a niche of immortality in aviation's annals. Tony Fokker's D-VII fighter was such an aircraft in World War I. Douglas' DC-3 was another in the initial growth period of commercial aviation.

In World War II, Vickers Supermarine Spitfire during the early defensive phase and North American's P-51 Mustang during the final long-ranging offensive phase also earned this accolade. In the era just ended that brought fighter performance up to the speed of sound, it is obvious that another North American Aviation, Inc. fighter design—the F-86 Sabre series—filled a critical gap in both hot and cold wars. In the period before fighters with straight and level supersonic performance went into service in significant quantities, it was the Sabre and its variants that provided the only first line fighter design for the U.S. and its allies capable of repulsing the challenge of the surprising Russian jet fighters appearing from the Mikoyan-Gurevich design team.

Now that we are well into a truly supersonic era of operational aircraft and guided missiles, we have a good perspective from which to survey the amazing record of the Sabre in the service of this country and its allies. It is extremely significant that the Sabre series did its entire job against formidable odds, ranging from more than two to one in the production battle to as high as 10 to one in combat over Korea in MiG Alley.

The Sabre series has been produced in five countries, including two North American plants, one in Los Angeles and the other in Columbus, Ohio. Canadair Division of General Dynamics built the Sabre design in Montreal; Fiat is building an all-weather version in Italy; Commonwealth Aircraft Corp. is building the Sabre in Australia; in Japan, Shin Mitsubishi is assembling the F-86F.

The basic Sabre design has gone through close to a dozen major model changes, including the use of five powerplants —General Electric's J47 and J73; Curtiss-Wright's J65, the Avro Orenda and Rolls-Royce Avon. A total of about 7,600 Sabres have been built all over the world in contrast to more than 15,000 MiG-15 and -17s produced by the Soviet Union and its satellites during the same period.

The Sabre design has flown operationally for both USAF and Navy and in the air forces of Canada, Britain, Australia, Italy, Japan and Turkey.

Like all modern aircraft, the Sabre design was essentially a team effort by North American Aviation, Inc.'s engineering staff, but certain individuals played key roles in its inception and development. Among them was Ray Rice, then chief engineer, who made the vital decision in September, 1945, to switch from conventional straight-wing design to 35 degrees sweepback when captured German wind tunnel data confirmed earlier NACA theories on the value of this device for high-speed aircraft. Others included Edgar Schmued, now engineering vice-president of Northrop; Ed Horkey and Harrison Storms, chief technical engineers on the project; R. L. Schleicher, chief structures engineer; Larry Green, chief aerodynamics engineer, and W. A. Spival, manager of weapon system production design.

The development history of the Sabre also provides a clue to the keen technical foresight needed to conceive on the drawing board weapon systems that will have superior combat capability six or seven years later. First design studies on the project that turned into the F-86 configuration were begun by North American in November, 1944, and bolstered by a USAF letter contract for three experimental prototype XF-86s in May, 1945. At this time, the proposed design had a straight wing and fell short of USAF's specification for a 600 mph. fighter.

Four months later, the significant decision was made by Rice to alter the wing design to sweep wing and empennage and reduce the wing thickness ratio to 11% at root and 10% at tip. This decision was based upon German data compiled for a sweptback version of the Messerschmitt 262 and was the same basic data utilized by Soviet designers Mikoyan and Gurevich for the MiG-15 destined to meet the Sabre in the first transonic combat over Korea.

The first XF-86 was completed on Aug. 8, 1947, and made its first test flight on Oct. 1. First production F-86A was delivered to USAF on Aug. 16, 1948. For the next five years, various model Sabres held official world speed records ranging from 650 mph. to 715 mph.

But the most significant test of the Sabre came in the final months of 1950. After taking a fearful lacing from USAF jet fighters and piston-powered fighter-bombers during the early months of the Korean war, Communist forces committed Russian-built MiG-15s flown by Red Air Force pilots to battle against USAF. Early clashes of the swept-wing MiG-15s against straight-wing USAF, Navy and Marine fighters indicated that, while occasionally possible to clobber a MiG, the straight-wing, Mach-limited fighters were no match for the swept-wing Soviet products. To meet this threat, USAF's Fourth Fighter Wing, first to be equipped with F-86As, was rushed to Korea.

On Dec. 20, Lt. Col. Bruce Hinton recorded the first MiG kill in a Sabre. For the next two-and-one-half years of the Korean war, the Sabres, despite severe diplomatic restrictions that prevented them from carrying the battle across the Yalu to MiG bases, kept the Communist air threat neutralized and fought epic air battles against odds that ranged as high as 10 to one in the combat area.

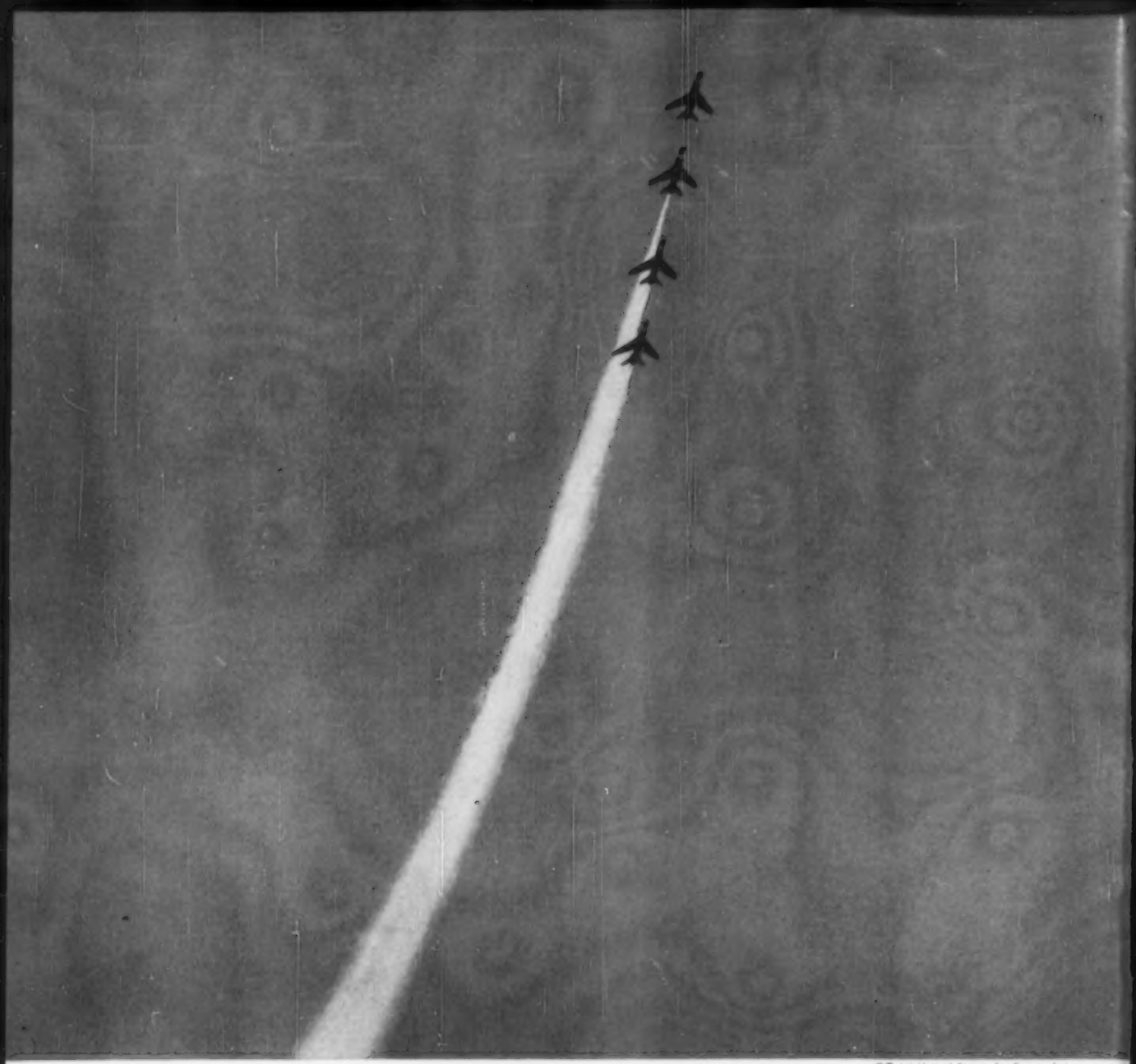
For many months, the Fourth Fighter Group based at Kimpo with less than 100 Sabres held the line with aggressive tactics against forces ranging up to 400 MiGs. The Fourth Fighter Group, and later the Fifty-First, fought without proper logistic and maintenance support and under the worst type field conditions, ranging from frigid winters to torrid, dusty summers, all heavily laced with gumbo mud. The Sabre proved itself a rugged fighter, both in the air where it could survive most of the heavy cannon pounding from MiGs and on the ground where it stayed operational despite minimum maintenance facilities.

Later, when Sabre production was more plentiful, this aircraft was adapted for fighter-bomber use in Korea.

After the first rugged days of the F-86A against MiG swarms, North American engineering and production resources rushed improved models to Korea that vastly improved the Sabres' combat capability. Rate of MiG kills went up significantly due to the combination of the improved F-86F performance and the switch from Russian to Chinese and North Korean pilots in MiG Alley. While the F model Sabre saw extensive combat in Korea, the Soviets were not able to get the MiG-17, their major model improvement, into operation before the end of the Korean war.

In addition to holding the line against Communist airpower in Asia, the Sabre also performed the same role in Europe. When the inferiority of straight-wing fighters was demonstrated in Korea, there was no other swept-wing fighter available to allied forces. Four hundred Canadair-built Sabres were sent to Britain's Royal Air Force for first-line air defense of the British Isles plus squadrons of RCAF and USAF Sabres sent to duty in Europe. U. S. Navy had no swept-wing fighters then available, so it turned to a quick redesign of the Sabre for aircraft carrier operations. This version is still being produced at the Columbus plant as the FJ Fury series for the Navy and Marines.

The Sabre, by its fighting and flying over the past six years when it held the line alone against the challenge of Communist airpower, has earned a niche among the truly significant aircraft in aviation history. —Robert Hotz



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WHO'S WHERE

In the Front Office

James Bere, president, Axelson Manufacturing Co., Los Angeles, Calif.

Richard B. Hubbard, vice president and assistant to the president, Pacific Airmotive Corp., Burbank, Calif.

Brig. Gen. Alfred R. Maxwell (USAF, ret.), vice president, Hallamore Electronics Co., division of The Siegler Corp., Anaheim, Calif.

Bernard S. Reckseit, vice president-engineering, Ransohoff, Inc., Hamilton, Ohio.

R. J. Seltzer, vice president-operations, Gladden Products Corp., Glendale, Calif.

Marvin B. Ruffin, vice president, Chicago Aerial Industries, Inc., Melrose Park, Ill.

Capt. Edward C. Callahan, Commanding Officer and Director of the U.S. Naval Training Device Center, Sands Point, N. Y. Capt. Callahan relieved **Capt. C. H. S. Murphy**, USN, now Director of Tests, Naval Air Missile Test Center, Point Mugu, Calif.

Dr. James T. Grey, scientific advisor, USAF Directorate of Research and Development, Washington, D. C. Dr. Grey is on leave of absence from Cornell Aeronautical Laboratory.

Honors and Elections

Edmund T. Price, founder of Solar Aircraft Co., has accepted a professorship of human relations at California Western University, San Diego, Calif. Mr. Price is retiring as Solar's board chairman.

Vernon I. Weihe, consultant to the Air Transport Association of America, has been elected president of the Institute of Navigation, Los Angeles, Calif.

Changes

Edward F. Conklin, division general manager, Learcal Division, Lear, Inc., Santa Monica, Calif.

Capt. Grayson Merrill (USN, ret.), director of engineering, Fairchild Guided Missiles Division, Fairchild Engine and Airplane Corp., Wyandanch, N. Y.

Fred Lilienstein, engineering supervisor, Advanced Development Laboratory, Perkin Engineering Corp., El Segundo, Calif.

Robert C. Wright, chief-production engineering, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn.

Bruce McKay, manager, newly established subcontracts department, Vertol Aircraft Corp., Morton, Pa.

John A. Lawrence, manager-aviation electrical systems engineering, Aviation and Defense Industries Sales Dept., General Electric Co., Schenectady, N. Y.

Henry Bechard, administrative engineer, Daystrom System Division, Daystrom, Inc., La Jolla, Calif.

John Roback, engineering manager, Data Reduction and Automation Division, Fischer & Porter Co., Hatboro, Pa. Also: **C. R. Lambert**, operations manager.

Harry N. Price, chief project engineer and manager of ramjet and dual cycle design, Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J.

INDUSTRY OBSERVER

► Boron high energy fuels which will be available to the military in substantial quantity by 1959 will boost the range of current jet bombers and fighters by approximately 40%. Turbojet engines will have to be modified to burn the fuel.

► Basic reason behind recent failures of Navaho intercontinental cruise missile tests from Patrick AFB, Fla., (AW July 8, p. 23) is failure of the liquid propellant booster to push the missile to sufficient speed for the ramjet engines to become operable. Booster must push the missile to speeds of between Mach 2.5 and Mach 3 before the ramjet engines can cut in.

► Piston engines may be boosted into a competitive position with turboprop powerplants by a new anti-knock compound developed by the Ethyl Corp. The compound, an organic derivative of manganese, has been tested by Curtiss-Wright. Tests showed that detonation margins in current engines were substantially raised. New reciprocating engines could use this improvement to boost power 20% and put piston airliners in the 400-mph. class.

► Lycoming has developed a mechanical alternator drive incorporating tilting rollers between two disks. Variable speed transmission is achieved by using gyroscopic forces to tilt the roller wheels so that they can contact the two disks along different diameters. Development was partially funded by the Navy.

► National Science Foundation plans an earth satellite designed to measure the heavy cosmic ray flux. Primary mission will be to record size and energy distribution of the flux without interference from atmospheric effects. Satellite, an extension of the earth satellite program, will be built by RIAS Inc., a Martin subsidiary.

► Second prototype of the Fiat G. 91 light ground attack fighter (AW June 10, p. 50) made its initial flight last week to begin an intense flight test program. Flight, piloted by Maj. Vittorio Sanseverino of Fiat, lasted 23 min. First prototype was lost when it developed tail troubles in a high-speed run at about 4,000 ft. altitude.

► Stromberg-Carlson Division of General Dynamics Corp. is developing a passive radar system for the Air Force. The division recently received a $17,528,850 contract for the project. Passive radar, a new technique developed for airborne surveillance and mapping, is essentially a hybrid between conventional radar and infrared (AW May 27, p. 23).

► New type artificial horizon displays are scheduled to be flight evaluated by USAF and Navy by the end of the summer. Features include sharp separation of earth and sky, easy reading by pilot using peripheral vision. Smallest unit will be approximately five inches in diameter.

► Sealed fuselage and outrigger system probably will be approach sought by New York Airways in future large turbine-powered helicopters to provide a safety factor for overwater operation. Present external floats on NYA's Sikorsky S-55s cuts speed performance by about 14 kt. An attempt to develop external floats that could be expanded on takeoff and landing, contracted for flight stages, resulted in an overly complicated system.

► U.S. Army is sending seven Sikorsky H-34 helicopters to Norway to haul construction supplies to microwave relay station sites inside the Arctic Circle. They will be provided by the 8th Transportation Battalion (Helicopter) at Munich, Germany. Based north of Oslo, the helicopters will take part in an around-the-clock operation. Twenty-two pilots will accompany the aircraft.

► Army also is sending one H-34 from Munich to England for installation of Decca navigation equipment. The helicopter will be used to test operation of the system in Europe.

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Washington Roundup

Contract Switch

Watch for increasing pressure from the military services on defense contractors, particularly in the aircraft and guided missile fields, to switch from cost-plus-fixed-fee to other types of contracts. The armed forces have been impressed by congressional criticism of CPFF contracts and their small element of risk for businessmen who boast of the chances they take. Many companies also want to abandon CPFF entirely because they can make more money on incentive-type contracts with less peril from the Renegotiation Board when the time comes to review their books. Air Materiel Command last week announced a $38,869,715 award to Douglas Aircraft Corp., "for change in type of contract for C-133 aircraft." Change was from CPFF to cost-plus-incentive terms. USAF and Douglas both prefer new arrangement.

Army to Join NACA?

Legislation expanding National Advisory Committee for Aeronautics by adding two representatives of the Army has been introduced by Rep. William Hess (R.-Ohio). There are now two USAF and two Navy representatives on the committee. The measure is pending before House Armed Services Committee, of which Hess is a member.

Hebert's Engine Hearings

Roy T. Hurley, chairman and president of Curtiss-Wright Corp., is scheduled to be the lead-off witness on July 18 before the House Armed Services Investigating Subcommittee in its investigation of the profits and procurement policies of aircraft engine manufacturers.

Curtiss-Wright will be followed by Pratt & Whitney Aircraft Division of United Aircraft Corp., Westinghouse Electric Corp. and General Electric Co. The subcommittee, headed by Rep. Edward Hebert (D.-La.), began its investigation in March with comprehensive questionnaires to 17 firms (AW Apr. 1, p. 27). The public hearings are expected to last about two weeks.

Other developments in Congress:

• **Bilateral agreements.** Senate Commerce Committee is expected to approve legislation tightening the requirements for the award of air rights to foreign carriers without hearings. The measure, sponsored by Sen. Warren Magnuson (D.-Wash.), chairman of the committee, and Sen. John Bricker (R.-Ohio), ranking minority member, explicitly writes into law the principles of the 1938 Civil Aeronautics Act and the 1946 Bermuda agreement, intended as the prototype for other bilateral agreements. Bricker claims this is necessary because the State Department in its "over-generosity" to foreign carriers has not followed these principles. The measure also directs Civil Aeronautics Board to review at least annually the operations into the U.S. of foreign carriers and require them to supply the necessary records and statistics.

• **CAB Disclosures.** Sen. Henry Jackson (D.-Wash.) hopes to obtain Senate passage this session of legislation penalizing "leaks" of information by CAB employes and attempts to influence CAB members. The measures, now pending before the Senate Judiciary Committee, resulted from an investigation of the Northeast Airlines case in which the premature disclosure of the award of a New York-Miami route led to quick stock market profits (AW May 13, p. 43). Jackson was chairman of this investigation by the Permanent Senate Investigating Subcommittee. The penalty set for both "leaks" by CAB personnel and "pressure" on Board members is a $500 fine, one year imprisonment or both. Before discussing a case with any Board member or employe, it would be required that all parties interested in the proceeding be given notice and an opportunity to participate in the discussion.

Twining Show Costly

USAF's show in honor of outgoing Chief of Staff Gen. Nathan F. Twining, new chairman of the Joint Chiefs, cost $400,000, it was disclosed in debate on the Senate floor on the Fiscal 1958 Defense budget. The cost of a reception at Andrews AFB near Washington for Twining before the show was $4,300. Sen. Wayne Morse (D.-Ore.) declared: "I think a much more effective monument to the service of Gen. Twining could have been built for him by way, let us say, of dedicating a needed veterans hospital in his honor—rather than to waste $400,000 . . . for an aircraft tinsel show." Sen. Leverett Saltonstall (R.-Mass.) explained that planes flew in from points from Maine to California "to demonstrate the effectiveness of the drilling and training required to put on an exhibition of that character on time. Every plane came in on time with the exception of one, which was one minute late."

Merger Disapproval

Civil Aeronautics Board last week established a precedent that may discourage future merger talks between local service carriers. In announcing its reasons for disapproving the proposed acquisition of Lake Central Airlines by North Central Airlines, the Board ruled that the merger would "create a local service system of unprecedented size engendering a tendency on the part of the carrier to concentrate unduly on the long-haul traffic, to the exclusion of its service to the smaller communities dependent exclusively on the local carrier for their air service needs."

The Board admitted that sizeable subsidy savings would possibly result if the two carriers merged but said this factor would not "outweigh the adverse effect on the overall public interest." The Board also found that Lake Central's future as an independent carrier is strong and suggested that the airline's system may be further strengthened in pending local service proceedings.

Congress Eyes Alcohol Bill

Chances that legislation banning the serving of alcoholic beverages on scheduled airlines will be passed during this session of Congress are good if any of several bills now in the congressional hopper manage to reach the Senate floor. Last year, an anti-liquor bill passed the House but died in the Senate. However, most observers feel that if such legislation now hits the Senate floor, most Senators will think it politically inadvisable to oppose it. The Air Transport Assn. and the majority of individual airlines have opposed the dry legislation and have termed as unfounded the charges that service of alcoholic beverages endangers safe operations. Air Line Pilots Assn. and stewardesses are strong proponents of the in-flight prohibition proposals.

—Washington staff

Industry Demand for Engineers Eases

Aviation Week survey doesn't indicate surplus, but reveals more, better qualified applicants.

New York—Shortage of engineers has eased noticeably within the past 90 days in the aviation-avionics industry. Companies are showing greater selectivity in their hiring than at any time since 1950.

This is the concensus of officials and top recruiters in more than 35 aircraft, missile, powerplant and avionics companies across the nation surveyed last week by AVIATION WEEK. Anonymity was assured to encourage companies to speak with complete candor.

There is no present indication of a surplus supply of engineers on a nationwide basis. Senior engineers, with 8-10 years' experience, and specialists are still very much in demand, AVIATION WEEK's survey shows.

This is true even for several companies that have recently been forced to lay off some engineers because of contract cancellations or as a result of a general culling operation.

The Evidence

More than 85% of the companies surveyed see indications of an easing in the situation. The evidence includes:

• **More applicants seeking positions.** Most, but not all, companies made this comment.

• **Quality of many applicants** is considerably above former average, according to some companies.

• **Increase of unsolicited inquiries** from areas where company has made no recruiting effort. One company reports replies to advertisements which appeared more than a year earlier.

• **Lower turnover of own engineering personnel.** This was reported by perhaps a quarter of the firms surveyed; nearly all the rest reported turnover unchanged.

• **Less aggressive recruiting** and less advertising for engineers in newspapers and trade journals.

The Situation

The present situation appears to stem from a combination of increasing supply and decreasing demand, rather than from either one alone. Here are the factors which have contributed to bringing supply and demand into better balance, according to the companies interviewed:

• **Less stockpiling of engineers** to meet anticipated future needs. One major West Coast avionics manufacturer says that a year ago this time it had hired engineers for every job it anticipated getting for the balance of the year. Now it is waiting until the contract is in hand before hiring.

• **Layoffs resulting from unexpected** contract cancellations. Major terminations recently at Martin, Bell Aircraft, Vertol, for example, suddenly injected a total of 200-300 engineers on the market, but these appear to have found jobs quickly, in part at least as a result of efforts by their companies. Decision of Underwood to get out of the large computer field produced a similar situation in the East Coast avionics field.

• **Bumper crop of new engineering graduates.** U.S. colleges this year graduated an estimated 32-34,000 engineers, roughly 25-35% more than in each of the previous three years. Nearly every company indicated that it had equalled or exceeded its desired quota of June graduates.

• **Lower turnover** has reduced the pressure on recruiting to provide replacements. The aviation-avionics industry employs an estimated 50,000 engineers with an estimated average turnover rate of about 15%. This creates a demand for 7,500 engineers merely for replacement. Thus any decrease in turnover eases the demand throughout the industry.

• **Weeding out less competent** engineers is taking place in a number of companies, because of the general easing in supply and demand, and this in turn contributes to the available supply. One major midwestern avionics firm says: "This is the first time in more than five years that we feel we can afford to weed out the accumulated deadwood."

• **Restrictions on Defense Department** spending in recent months has hurt some companies, particularly smaller ones without extensive capital, forcing them to release some engineers.

A few observers believe that the engineering shortage may bounce back as soon as new fiscal year funds find their way into new defense contracts, but this feeling does not appear widespread.

Few companies will admit that they have not been selective in their past hiring but practically all of them say they now are "very much more selective." A year ago, a graduate engineer could present himself to almost any company's recruiter and receive an offer almost instantly.

Specific Opening

Today, the recruiter will examine his qualifications carefully. Unless the applicant is an above-average engineer or a specialist who can fill a specific vacancy in the company's staff, he will be told that the company will call him when they have an opening.

One major East Coast avionics company, which until recently had been conducting an aggressive recruiting campaign, has completely terminated its recruiting. An official says the company now has sufficient engineers to meet present needs, except for a few specialists.

On the other hand, a few of the firms surveyed recently received major contract awards and are actively seeking to enlarge their engineering staffs. One major East Coast avionics firm, which says it has always maintained high hiring standards, must take on more engineers in the next six months than it has ever hired before in the same period. It is one of the few companies that has seen no easing in the supply of engineers.

Hiring Despite Layoffs

Bell Aircraft and Martin spokesmen report they are recruiting actively, despite recent layoffs of a modest number of engineers. Major contract cancellation forced Bell to lay off about 80 graduate engineers (about 6% of its total), mostly chemical and mechanical engineers with less than two years experience. Currently Bell has specific requirements for about 100 senior engineers with experience in aerodynamics, hydraulics and systems engineering.

Martin, which recently laid off about 90 engineers (less than 5% of its total), also is actively recruiting engineers for its Baltimore, Denver and Orlando divisions.

However, both Martin and Bell officials emphasize that their standards are considerably higher than previously.

Companies were asked to indicate which types of engineers were now in easier supply, which remain tight. The responses were mixed. Two jet-engine manufacturers indicated that electrical engineers were easier to come by, while two others indicated that mechanical engineers were easier and electrical engineers more difficult. A Midwest avionics firm reports a number of appli-

Aviation Week's report on recent easing of the engineer shortage was written by Avionics Editor Philip J. Klass. Material for the survey was gathered and compiled by Klass, Engineering Editors Robert H. Cushman, Irving Stone and Russell Hawkes, the latter two in Aviation Week's Los Angeles Bureau, and Craig Lewis of Aviation Week's Dallas Bureau.

cants with airframe and engine experience, but its primary need is for electrical engineers.

There is some indication that the supply of mechanical engineers generally is up and that the demand for competent electrical engineers exceeds the supply.

Industry officials emphasize that a top-notch aerodynamicist, thermodynamicist, systems engineer, or antenna designer, to cite a few examples, generally will find many openings even in today's tighter market.

The Future

Few of the companies surveyed indicate any plans to cut the size of their present engineering staffs, although a number indicate they are reviewing their staffs in light of present commitments. One major West Coast missile firm has substantially reduced its engineer hiring rate because of uncertainties over Defense Department policies. Another West Coast airframe company is hiring only about half as many engineers as it was a year ago.

As the demand for engineers eases, the pace of recruiting has slowed. About one-fifth of the firms interviewed say they have drastically curtailed, or stopped completely, their manpower-wanted advertising and recruiting trips. Another 40% are cutting back on these activities. The balance plan no changes, although some of these have recruited on a modest scale even during the depths of the shortage.

Current recruiting ads have begun to reflect the industry's search for experts in specialized areas instead of the shotgun approach previously used to appeal to all types of engineers.

The comparatively few recruiting suites in operation at the recent military electronics convention in Washington, and the relatively few job offers posted on the convention bulletin board, are another indication of the situation.

Some technical recruiters expressed the view that the engineer shortage has been greatly exaggerated. They point out that any out-of-balance in supply and demand tends to feed upon itself whenever the quantity of the product can not be quickly increased to match demand. They believe, therefore, that the current shakedown will provide a more realistic appraisal of the true extent of the nation's engineering needs and pinpoint specific areas of serious shortage.

The new trend obviously will meet USAF approval. At the Convair B-58 rollout in Dallas (see page 28) Lt. Gen. C. S. Irvine, USAF deputy chief of staff for materiel, repeated a complaint that industry has tended to solve engineering problems by "smotherization," emphasizing quantity rather than quality in engineering personnel.

Boron Fuel Stability Improved, Full Production Starts in 1959

By J. S. Butz, Jr.

Niagara Falls—High energy boron fuels, without their usual toxicity and propensity to explode, are being delivered to the military in engine test quantities in much the same manner as conventional petroleum fuels.

This is the culmination of a major chemical research effort lead by the Olin Mathieson Chemical Corp. and Callery Chemical Corporation. The problem was to retain the high heating value of boron-base fuels while improving their very hazardous stability and handling qualities.

Next task before the companies is to develop large production capacity for their new fuels. This moved a step closer last week when Olin Mathieson laid the cornerstone here for a $36-million plant they will build and operate for the Air Force. Callery previously broke ground on a $38-million Navy plant at Muskogee, Okla. Full production in these facilities will begin in 1959.

Exact output is classified but it will be several times the capacity of present development facilities. Olin Mathieson has three units in operation now. The largest, representing a $5.5-million company investment, began producing on a semi-commercial basis last month. Its output will allow a much greater rate of engine test work. An experimental laboratory and pilot plant are also in use. In addition the company will put a Navy plant slightly larger than any of these in operation this year.

Borane Advantages

Boranes (compounds of boron and hydrogen) are generally considered to be the ultimate chemical fuel for aircraft (AW Nov. 2, p. 51). They satisfy primary requirement of higher heat of combustion than hydro-carbon fuels such as gasoline. This is true of each of the compounds of the lighter weight elements. It makes all of them theoretically attractive for use as aircraft fuel because of their high energy content per unit weight and volume. However, there are only two which have more potential than the boranes.

Hydrogen which has the highest heat of combustion is handicapped by its very low density requiring large storage space and refrigeration system on an aircraft. Beryllium also has a higher heat of combustion than the boranes, but it is in very short supply, and its compounds are extremely toxic.

Handling disadvantages of the boranes which were somewhat less critical than those of beryllium have been overcome so successfully that Olin Mathieson engineers carry bottles of their new fuel in their briefcases.

Primary differences between the fuels developed by Olin Mathieson and Callery are the methods of manufacture and the names. Names are HEF (High Energy Fuel) and Hi-Cal respectively.

End products are essentially the same and each company has achieved a relatively stable and docile fuel.

Currently there are two types of borane fuels and the trade names are HEF-2 and HEF-3 or Hi-Cal-2 and Hi-Cal-3 depending on the producer. The -2 fuel is derived from pentaborane and the -3 from decaborane. This suggests that each fuel is tailored for use in a specific type of aircraft.

Weight or Volume

Pentaborane has more heat energy per unit weight than decaborane, but the advantage lies with decaborane in heat energy per unit volume. Therefore:

- **The -2 fuel** would be more efficient in a large aircraft where weight is more critical than volume.
- **The -3 fuel** would be used in small dense aircraft where small volume is required.

As they stand today the borane fuels can probably be used in rockets, ramjets, and afterburners, but not in conventional turbojets. This is because the solid combustion products of the metal boron must pass through the turbine blades, causing erosion.

However, there is some optimism that the composition of the fuel may be altered so that the combustion products will tend to coat and glaze the blades. This could mean an increase in engine power if higher turbine temperatures were allowed after a break-in period at lower temperatures to coat the blades.

The flame propagation properties of the new fuels are much better than those of the hydrocarbons. This means a weight savings due to a shorter combustion chamber, and less likelihood of flame-out due to lack of air at altitude.

The borane fuels mean that within the next four or five years that the performance potential of aerial weapon systems will rise considerably even if no significant advances are registered in aerodynamics or propulsion. They mean a 40% increase in the range of an aircraft with a given volume of fuel. If range is held constant, then speed may be increased by reducing fuselage volume and area.

CONVAIR'S supersonic B-58 Hustler, powered by four J79 engines, is 97 ft. long with wingspan of 57 ft. and carries three-man crew.

Irvine Details B-58 Design Advances

By Craig Lewis

Ft. Worth—Convair B-58 Hustler, fastest jet bomber in the world today with a speed approaching Mach 2, represents highly significant new design breakthroughs, according to Lt. Gen. C. S. Irvine, Air Force deputy chief of staff, materiel.

Gen. Irvine pointed out that the U.S. has no other bomber to match the B-58's speed and said that "from what I have read and seen, I am equally sure the Soviets don't either."

Irvine's observations were made at the public unveiling of the supersonic bomber at Convair's Fort Worth Division plant last week. (First detailed pictures and description of B-58 was published by AVIATION WEEK Dec. 17, p. 26.) The Hustler's speed capability lies in two important design advances which make it possible, Gen. Irvine said. These breakthroughs were the development of the area rule fuselage and development and use of sandwich material for the bomber's skin.

While the new fuselage contour was an important step, Gen. Irvine feels the development of heat and fatigue-resistant honeycomb fiberglass and metal skin material "is one of the most vital achievements in recent years."

The material was a major breakthrough for the B-58, Irvine said, but perhaps more important in terms of long-range technological progress, it paves the way for advanced missile development and for even more advanced aircraft in the future.

Gen. Irvine observed that future aircraft and missiles will need materials not yet discovered. He pointed out that the immediate goals are set at Mach 3 and extended flight at 75,000 ft. and above and that, within the next few years, the aim is Mach 10 for manned vehicles and more than 15,000 mph. for missiles. Manned aircraft are expected to reach altitudes of 25 miles and more, and missile altitudes will range from 200 to 700 miles.

Discussing the B-58, Gen. Irvine said, "We are now at the point where we know how to make it go faster than it was designed to go." He said some modest changes in the J79 engines will make the aircraft go even faster. Modifications will be compressor changes.

Speed Bonus

Another speed bonus comes from the fact that the B-58 sandwich material shows greater ability to absorb heat than was previously thought.

Gen. Irvine said preliminary test programs have verified the manufacturer's estimates of the B-58's performance, but he said the Air Force is not ready to place a large production order. The general pointed out that past policy has been to order new aircraft slowly when they are still in the test stage. He said that in the next six months, USAF's main concern will be to decide how many more test-stage Hustlers to order. Convair now has an order for 13 aircraft, and the Air Force is expected to order 18 more for test purposes.

Pointing out that the B-58 is basically a successor to the medium-range B-47, Gen. Irvine said the new bomber's gross take-off weight is about 40,000 lb. less than the 100 ton gross weight of the B-47. The B-58 is 97 ft. long and 31 ft. high, and it has a wingspan of 57 ft.

Best operational technique is to cruise the B-58 at subsonic speed to the target area, then make a dash at high supersonic speed, according to Gen. Irvine. He said the B-58 handles nicely at Mach .6 for refueling from the KC-135, and that the bomber can even be refueled by the KC-97.

Hustler's first pilot was B. A. Erickson, Convair's manager of flight and chief test pilot, who flew the bomber in a flight demonstration last week at Ft. Worth. Erickson said the B-58 "will pose no problems whatsoever for pilots moving over from other jet bombers." He said the Hustler is very well tailored to accommodate an extremely wide spectrum of performance and is a very "trustworthy" aircraft.

Frank W. Davis, chief engineer at Convair-Ft. Worth called the B-58 a successful attempt to reverse the trend toward larger bombers. He said this reversal of trend is possible because of advances in nuclear weapon technology. "Bigger bangs from smaller bombs opened the door to smaller, less expensive and more effective bombing systems."

Discussing the delta wing Convair has used on both the F-102 and the B-58, Davis said its low-speed flight characteristics make both aircraft very "forgiving" machines. This means they give pilots wide variations in approach and landing techniques "without suddenly injecting lethal surprises as the price of straying from the optimum

speed, rate of descent, angle of attack and the like."

On the other hand, Davis said, the delta wing with its high taper can be made thin and strong, still retaining sufficient space for use as a fuel tank. The sweepback of the leading edge helps reduce high-speed drag, and the length of the delta permits deletion of the horizontal tail. All these features add to the delta wing's "high-speed charm," Davis said.

Security banned the disclosure of the B-58's top speed. Davis described the Hustler's speed by saying that the bomber's cruise speed is higher than the top speed of previous bombers. He also said that the B-58 provides a greater increment in top-speed advantage over the latest operational bomber —the B-52—than that bomber provides over the Wright brothers' airplane.

Davis said the General Electric J79 engine which powers the B-58 "has behaved very well indeed during the test program and promises further performance advances in the future." He said special treatment of the engine air inlet and exit has been necessary to realize the best propulsive efficiency over the wide speed range covered by B-58.

Structural Efficiency

Extensive use as primary structure of aluminum and stainless steel honeycomb sandwich materials has made possible required advances in structural efficiency and smoothness, Davis said. Sandwich material is light and not susceptible to buckling from aerodynamic heating. It also provides insulation to prevent excessive fuel boil-off during long supersonic cruise missions.

In spite of these advances in materials, high temperature remains the limiting factor in B-58 performance. The bomber is not thrust-limited—at the top speed allowed, there is still thrust available. The speed limit is set by heating considerations.

Bombing and navigation system for the B-58 was designed by Sperry Gyroscope Co., and Davis said the system provides an increase in accuracy of 10-fold over its predecessors while requiring only two-thirds the weight and volume.

Use of the pod allows the B-58 to return home clean without the waste volume of an empty bomb bay and without the waste weight and volume in an empty fuel tank, Davis pointed out. He also observed that the pod concept allows immediate advantage to be taken of advances in warhead technology. Pod can be tailored to the latest bomb "with no excess volume and weight to push through the air."

Praise for the weapons system management concept under which the B-58 was developed was expressed by August C. Esenwein, Convair vice president and manager of the Ft. Worth Division. Esenwein said he believes the weapons system concept has had and will continue to have a positive and beneficial effect on aeronautical engineering, development and production.

Esenwein said early studies in the B-58 program showed that, to meet operational requirements, the airframe, engines and all electronic equipment would have to be perfectly matched. In order to meet these requirements, Convair found that all new equipment would have to be designed to blend efficiently in one product—the B-58.

Sixteen companies were called in to produce the major items and subsystems in the aircraft. Out of every dollar received by Convair as prime contractor, 47.2 cents goes to builders of major and minor subsystems for the B-58. When other outside sources are paid, Convair has 28.7 cents of the dollar left to cover airframe design, development, testing and manufacturing, as well as for systems integration, installation and evolvement and for its weapon system management effort.

In the B-58 program, there are more than 1,200 vendors of raw materials, off-the-shelf equipment and standard and non-standard items. Another 2,400 vendors are furnishing operating supplies, special test equipment and facilities items. Esenwein said there are more than 20,000 firms in all 48 states supporting the B-58 program at second and third-tier levels.

Listing results on the weapons system management technique as applies to the B-58, Esenwein pointed out that the program is on schedule, performances predicted are being met or exceeded, on-time availability of vendor-furnished items has been notable, and technical and functional objectives for subsystems originally established are being met in virtually all cases. And total time from program go-ahead to first flight was short.

Engineering Talent

Esenwein said that 5,008 engineers are engaged in the B-58 program. Of these, 2,612 are in the Convair plant and 2,476 work for vendors. Of the 2,476 engineers in vendor's plants, 80% are electronics engineers.

Gen. Irvine also commented on the engineering situation, pointing out that in general, industry has tended more and more to solve engineering problems by "smotherization"—by applying engineering talent in terms of quantity rather than quality. He said industry should "quit the shotgun approach" in the use of engineering talent and should pick out the most important projects and put the best engineers available on them.

Navaho Canceled

Washington—Air Force late last week announced that it is canceling further development of North American's Navaho intercontinental cruise missile for budget reasons and because the missile is based upon "an earlier state of the art."

Development of the Navaho, powered by Curtiss-Wright ramjet engines and a North American booster unit, was begun in 1946. Recent flight tests of the missile from Patrick AFB, Fla., have failed because of the inability of the booster to push the Navaho to sufficient speed for the ramjet engines to become operable **(see page 23).**

USAF still plans to place its second air-breathing intercontinental missile, the Northrop Snark, into operational units of a limited basis. A $73 million production order for the Snark was announced earlier (AW July 8, p. 27).

USAF Ballistic Missile Record

Here's a rundown of USAF firings, and the results, of the Douglas Thor intermediate range ballistic missile and Convair's Atlas intercontinental ballistic missile from Patrick AFB, Fla. Most successful firing to date has been Army's Jupiter IRBM which reached an altitude of approximately 300 mi. and traveled more than 1,500 mi. (AW June 10, p. 25):

• Thor. Three fired thus far. First missile encountered a valve malfunction a few inches above the ground, resulting in its destruction. Second missile went 10 ft. off the vertical after takeoff and was destroyed by the range safety officer. Third missile was destroyed on the pad during refueling (AW May 27, p. 25) when a fuel pressure regulator malfunctioned.

• Atlas. Only firing to date resulted in missile destruction after the engine gimbaling system malfunctioned (AW June 17, p. 27). The missile had undergone a total static firing time of 700 sec. prior to launching. The latest was a 35 sec. static run on Tuesday, June 4. The missile was given a 10½ hr. countdown prior to firing on June 11. During the launch, the engine operated for 32 sec.—10 on the ground, 22 sec. in the air. Despite the short flight duration, Convair missile engineers estimate that they received 95% of the engineering data anticipated (AW July 1, p. 23).

Local Taxes on Aircraft Industry Hinge on Beneficial Interest Ruling

By Richard Sweeney

Los Angeles—Tax relationship between defense contractors and local governments may undergo complete upheaval as result of test case now being fought in California courts.

Basic question is whether local political subdivisions can assess companies for a possessary interest in government-owned facilities being used to manufacture items for the government, and assess work in process for the government on a basis which uses wording different from possessary interest but which means substantially the same.

Changing technology helped bring situation about. Prior to the late 1940's except during World War II, airframe plants were contractor owned and operated to major extent; contractor bought materials and built planes which were sold to government. By late 1940's, complexity necessitated government help with tools, floor space, resulting in contractor doing much work with government equipment in government facilities.

Tax Chronology

In 1953, led by Los Angeles County, several political subdivisions began assessing companies for taxes based on possessary interest in this government-owned portion of the airplane manufacturing complex. Before that, government interest had been such that it was not feasible to assess on this basis.

In 1954, Aerojet-General Corp. and Convair Division of General Dynamics filed suit against Los Angeles County in a test case, charging assessment was illegal.

From 1953 to 1956, airframe-missile primes and large subcontractors were involved. In this period, Los Angeles, San Diego and Alameda counties and the city of Long Beach, have collected some $22 million on this basis from the large companies. However, Department of Defense actually paid the taxes by allowing them as reimbursable costs on contracts with companies.

In 1957, Los Angeles County changed assessment base to charge companies with additional possessary interests, in designs themselves as proprietary items; government-owned, contractor-operated-tooling and test equipment, and inventories. Tooling and test equipment are regarded as productive personal properties wherein contractor has possessary interest; inventories are considered passive personal properties in which contractor has possessary interest, properties which eventually will be turned into various products.

Broadening assessment base this year raised to several hundred the number of companies taxed for possessary interest in government items, and expanded the field to include small avionics development firms, equipment manufacturers and others.

In addition, new assessment policy is expected to raise the total taxes collected to nearly $45 million, in one year adding an amount about equal to the four preceding years together.

On June 10, Los Angeles Superior Court handed down a decision in the Aerojet-Convair test case, holding the assessment and tax illegal. Los Angeles County is preparing its appeal to California Supreme Court which takes direct jurisdiction from trial court in tax matters if case is sufficiently important.

Meanwhile, Defense Department ruled it no longer will allow the tax on contracts in view of Superior Court ruling (AW July 8, p. 28).

With Defense Department no longer allowing taxes as cost in contracts, companies face paying increased assessments from their own funds for several years until final court decision is reached.

Typical companies, amounts they paid Los Angeles County in 1953, 1956 and the projected 1957 taxes, respectively, are:

- **Douglas**—$1,932,140, $1,122,490 and $6,372,696.
- **Hughes**—$252,575, $272,163 and $1,817,675.
- **Marquardt**—$19,348, $12,922 and $67,479.
- **Rheem**—$268,192, $197,496 and $286,857.

Revenue Expectations

San Diego County has assessed Convair there on the same basis as Los Angeles has assessed companies within its confines. Also hit in San Diego are Rohr, Solar and Ryan.

Alameda County in San Francisco Bay area has taxed Douglas and Lockheed through subcontractors. Lockheed was charged $4,567 for government items which Kaiser Co. built on subcontract from Lockheed for the Navy, the items being stored on Kaiser property there by Lockheed at Navy direction. Douglas has had airplane subassemblies fabricated by Western Sky Industries and paid the county there $53,277 over the years 1953, 1954, 1955 and 1956 on the basis of possessary interest.

City of Long Beach taxed Douglas in 1954, 1955 and 1956 a total of $205,249 on the basis of company possessary interest in government items in company's Long Beach plant.

Los Angeles County expects revenues of $18.5 million in 1957 on expanded assessments. Prior years totals are $17 million. Total assessments this year including possessary interests are $265 million, the assessed values, of inventories set at $200 million, tooling and related items, $65 million.

Philip Watson, defense materials appraiser of Los Angeles County Assessor's office, cites court precedent for county stand in January 1957 decision by Wisconsin Supreme Court in case of City of Kenosha vs. American Motors. Wisconsin's high court held that while naked title to items made by company lay with government, beneficial ownership rested with company, thereby legalizing municipality's right to assess company for its interest in the items. In this case, trial court found for municipality, was overruled by appeals court and was finally upheld by state high court which reversed appeals court and sustained trial court ruling.

While California test case deals with narrower base of assessment on fewer companies than exists today Watson said no plans exist now to reopen tax years 1953 through 1956, reassess the small companies which were first brought into the fold on the expanded 1957 assessment base.

Stroukoff, Air Force Study C-134 Contract

West Trenton, N. J.—Stroukoff Aircraft Corp. last week was reported to have reached an agreement with the Air Research and Development Command under which work on the C-134 twin engine transport project will be continued under a fixed price contract.

USAF earlier had ordered the company to stop work under the previous cost-plus-fixed-fee arrangement because costs had exceeded estimates by a wide margin. Stroukoff's plant was closed from July 1 to July 15 while the new arrangement was worked out. Originally, vacation shutdown was scheduled for the last two weeks in July.

Size of the new fixed price contract was reliably reported to be in the neighborhood of $1.5 to $2 million, for which the company would be required to complete work on the second and third aircraft. USAF originally had provided about $10.5 million for the three planes. The second is understood to be about 90% completed and the final model about 70% finished.

President Michael Stroukoff last week was at Wright-Patterson AFB, Ohio, negotiating the new contract. The company is reported to have dismissed about 20 engineers.

Defense Missile Secrecy Hobbles USAF

By Katherine Johnsen

Washington—USAF's Office of Information Services is now taking active steps to try and make more information available on the guided missile firings from Patrick AFB, Fla., a move predicted by AVIATION WEEK on June 24 (p. 25).

Brig. Gen. Arno H. Luehman, director of OIS, told the House Government Information Subcommittee last week that a rigid Defense Department directive prohibiting disclosure of any details except confirmation of the fact that a test firing has occurred and "a brief statement" as to any casualties "is not serving our interests."

Gen. Luehman said he is concerned over the erroneous impression being created by firing failures. "We ought," he added, "to give the public a correct picture as to how far we have progressed in the missiles field for the money spent."

The failures have been valuable, Luehman emphasized. He said a first firing that was 100% successful would be "practically valueless" since "it might have happened to work that first time" whereas failures point out specific troubles.

He said he intended to urge USAF Secretary James Douglas to request Defense Secretary Charles E. Wilson to liberalize the directive.

Although the Air Force can give no advance notice of a firing, Gen. Luehman conceded that residents in the vicinity of Patrick AFB are aware of unusual activity and can easily deduce this fact.

Luehman also publicly disclosed that an Air Force Office of Security Review will shortly be established within the information office (AW June 24, p. 25) to speed up declassification. Army and Navy already have security review offices.

No Press 'Purloining'

Brig. Gen. A. J. Kinney, former USAF information director, and Rear Adm. E. B. Taylor, Navy's chief of information, all said they knew of no instance in which security information had been "purloined" for press publication as charged by Loyd Wright, chairman of the Commission on Government Security, (AW July 8, p. 25).

Gen. Luehman and Adm. Taylor reported that their offices were not contacted by the commission in drawing up its comprehensive 800 page report (AW June 24, p. 39 and July 1, p. 34). Subcommittee Chairman Rep. John Moss (D.-Calif.), commented that "it seems to me that . . . it would be most important to talk to people directly concerned."

Moss developed in his questioning of Luehman that two specific charges of a security breach by Charles A. Coolidge, chairman of Defense Department's Advisory Committee on Classified Information, were unjustified.

Coolidge Refuted

In earlier testimony before the subcommittee, Coolidge had claimed:

• **That a disclosure of** USAF guided missile contractors in August, 1956, "was not at all helpful to our national security." Gen. Luehman reported that the information, contained in a speech by Brig. Gen. Don R. Ostrander, Deputy Commander for Resources of the Air Research and Development Command, had been cleared by Defense Department's Office of Security Review.

• **That "a number of people in the** Pentagon felt" that the 1,900 mph. speed record of the Bell X-2 research plane should not have been published in August, 1956. Gen. Luehman said the Air Force had approved publication of the figure but that the Defense Department overrode this clearance. He added, however, that the figure could have been deduced from a speech made by Gen. Nathan F. Twining, new chairman of the Joint Chiefs of Staff and USAF Chief of Staff at the time.

USAF's handling of the first release of Convair B-58 pictures was described by Subcommittee Counsel John J. Mitchell as "an attempt to classify the unclassifiable." Although USAF did not release photos of the B-58 until last Dec. 26, Rep. Moss pointed out that "anyone was able to take pictures" of the aircraft from the time of its initial taxi test on Oct. 29 at Convair's Fort Worth plant. To emphasize his point, Moss exhibited a picture of the aircraft being photographed by onlookers outside the plant's fence. The photograph was published by AVIATION WEEK on Dec. 24 (p. 33) to make the same point. Other pictures of the aircraft had appeared in earlier issues of AVIATION WEEK.

Luehman opposed removal of the classification "confidential" as proposed by the Commission on Government Security and predicted that it would result in a wholesale upgrading of information.

Meanwhile, legislation required to implement key recommendations of the commission, headed by California Attorney Loyd Wright, has been introduced:

• **Central Security Office.** Measures to establish a Central Security Office to coordinate and establish policy for all security and loyalty programs were introduced by Sen. Olin Johnston (D.-S.C.), chairman of the Senate Post Office and Civil Service Committee; Rep. James Murray (D.-Tenn.), chairman of the House Post Office and Civil Service Committee, and several others. The office would be composed of a director, two assistant directors and a three-member Central Review Board. The measures are pending before the two Post Office committees.

• **Unauthorized disclosure.** Legislation making the unauthorized disclosure of classified information a criminal offense was introduced by Sen. Norris Cotton (R.-N.H.) and Sen. John Stennis (D.-Miss.). It would apply to persons both in and out of government. The penalty, as recommended by Wright, is a fine of not more than $10,000 or imprisonment for not more than five years, or both.

• **Wire-tapping.** Another measure sponsored by Cotton authorizes government security officers, upon written authorization by the Attorney General, to "intercept any wire or radio communication."

• **Visas.** Legislation transferring the function of issuing visas from the State Department to the Immigration Service of the Department of Justice also was introduced by Cotton. The measure would at least ease a problem international airlines have long protested—despite the fact that a passenger with a one-way ticket may have a visa issued by the State Department abroad, he can be refused admittance on arrival in the U.S. by the Immigration Service and the air carrier may be liable to furnish his return transportation and also be subject to a fine.

• **Military Loyalty.** Another Cotton-sponsored bill sets guidelines for determining cases involving the loyalty of members of the armed services. It provides for boards of inquiry to be comprised of three officers senior in rank to the person involved.

X-17: 9,268 mph.

Washington — Defense Department last week officially announced that Lockheed's X-17 hypersonic test vehicle has reached the "highest speed ever achieved by any instrumented missile."

As reported in Aviation Week on April 29 (p. 30), the X-17 reached a speed of over 9,000 mph. during the record flight from Patrick AFB, Fla., early this year. Actual figure still has not been disclosed by the Defense Department, but it is understood to be 9,268 mph.

Lajes Field in Azores Provides Atlantic Stopover Service for USAF

By Claude Witze

Lajes Field, The Azores—About 2,300 miles east of New York and 1,000 miles west of Lisbon, this key USAF installation stands in the mid-Atlantic virtually without any air defense.

The 1,800 Americans resident at Lajes Field are guests of the Portuguese government, and defense of the island is not part of their mission. The 500 Portuguese at Lajes are here for housekeeping purposes, cooperating with USAF and the U. S. Navy on weather services, traffic control and communications.

Long-Range Planning

The Portuguese have only six aircraft, all used for air rescue missions. They are three converted B-17 bombers and three Grumman SA-16 seaplanes. Technically, defense of the islands is up to the Portuguese, but it is clear that there are no weapons or planes available for that purpose.

Navy spokesmen say their long-range program includes plans to extend the U. S. picket plane radar warning line east to Lajes Field, but no date has been set for this expansion. The base at present is not equipped to handle regular operations of picket planes working on the "air barrier" but is prepared to serve as headquarters for aerial anti-submarine forces in the event of war.

Lajes Field today is an essential facility for USAF, providing a refueling and passenger service station for trans-atlantic flights of the Military Air Transport Service.

At frequent intervals it also serves as a base for tanker aircraft of the Strategic Air Command and Tactical Air Command. While there are no permanent facilities at Lajes for this mission, units of SAC and TAC operate out of the airport for refueling of bombers and fighter planes en route to and from Europe.

USAF Facilities

Lajes is the home of the Azores Air Transport Station (AATS), the 1605th Air Base Wing and the U. S. Forces in the Azores (USFORAZ). USFORAZ is under the commander-in-chief, Atlantic (CINCLANT).

Commander of the 1605th Air Base Wing and AATS is Brig. Gen. Harold L. Smith, who also serves as commander of USFORAZ. Capt. John R. Diffley of the U. S. Navy is USFORAZ chief of staff.

Value of Lajes Field is estimated at $200 million. Transient flights total as many as 1,200 departures each month.

Meals and stopover accommodations are provided for 15,000 to 20,000 persons each month.

The 1605th Air Base Wing of the Atlantic Division of MATS has responsibility for this billeting and feeding, along with the refueling and maintenance of aircraft.

It is supported by the 1936th Air and Airways Communications System Squadron, Detachment 3, the 9th Weather Group of the Air Weather Service and the 57th Air Rescue Squadron.

Army Representation

Army is represented by the Corps of Engineers to supervise civilian contract construction and the 7279th Transportation Terminal Detachment, which is charged with unloading and loading ships in Paria Bay Harbor.

U. S. Navy personnel in addition to those at USFORAZ headquarters include Fleet Aircraft Service Squadron 106 (FASRON) and a communications unit.

USAF has only 11 aircraft assigned to Lajes Field. Six are used for air-sea rescue coverage and five are assigned to the 1605th for station support and combat readiness training.

The ARS unit has not had an accident since it was activated in 1949. The 1605th has had a perfect accident record for three and a half years.

U.S. interest in the Azores dates from World War II when the Air Transport Command, predecessor of MATS, established an air station on Santa Maria Island. In 1946, the base was moved to Lajes Field on Terceira, which had been used by the British during the war. The airport at Santa Maria now serves as a commercial airport for the islands.

LAJES FIELD on northeast tip of Terceira Island handles as many as 1,200 transient flights per month for MATS and other U. S. military services.

SERVICEMEN and dependents moving to and from assignments in Europe, Africa and Middle East cross paths at Lajes.

Unification Improves Pacific Air Strength

Tokyo—Unification of U.S. forces in the Pacific and Far East under a single command will greatly increase the combat effectiveness of air units in the area, Gen. Laurence S. Kuter, commander of these newly combined units, told AVIATION WEEK last week before moving his headquarters from Tokyo to Hawaii.

"We have attained for the first time," he said, "the capability of exploiting fully the flexibility and mobility inherent in our combat units, which can now be moved in a matter of hours where days were required previously."

Until July 1, the Far East Command in Tokyo under Gen. L. L. Lemnitzer, and its air arm, the Far East Air Force under Gen. Kuter, embraced most of Free Asia north of Formosa, including the bases of Japan, Okinawa and South Korea.

More Mobility

U.S. forces outside this arbitrary line, mainly in Formosa, Philippines and Hawaii, were under Adm. Felix E. Stump, commander-in-chief, Pacific (CINCPAC), in Hawaii. Air units, while operationally responsible to this headquarters, were administratively under FEAF.

Movement of any unit from one command area to the other required authorization of the Joint Chiefs-of-Staff in the Pentagon.

Now, with virtually all forces in the Pacific-Far East under the centralized command of Admiral Stump—and air units under General Kuter—movements anywhere in the area can be approved almost immediately. Moreover, plans for the defense of Free Asia as a whole can now be developed with maximum efficiency.

Only the B-47 wing of the Strategic Air Command in Guam remain outside Admiral Stump's command, being directly responsible to the Joint Chiefs-of-Staff.

Korean Exception

In South Korea some complications exist in that Gen. George H. Decker is both U.S. local commander and new U.N. commander-in-chief replacing Gen. Lemnitzer. It was decided not to move the U.N. command to Hawaii due to political considerations.

Consolidation of U.S. forces represents a victory of Air Force viewpoint over that of the Army. Use of airpower is facilitated and the role of the Army deemphasized in Asian defense strategy. Consistent with this new strategy, Japan, which has been essentially a ground theater since the occupation, is being turned into an air and naval base exclusively, with all U.S. ground combat troops scheduled to leave.

Unification meets a need made urgent by recent consolidation of Red Chinese, North Korean and Soviet Far Eastern air forces. Even with this move, the Communists hold an important immediate advantage. They are estimated to have about 8,000 planes, including more than 5,000 jets, based in the Far East, with heavy concentrations in the Vladivostok and Port Arthur regions and opposite Formosa. Communist bases are increasing and constantly being improved.

American aircraft number only about 3,500, including 2,500 jets, stationed at about 30 major and 10 small bases. This disadvantage is outweighed to a large extent, according to Gen. Kuter, by the superior overall airpower of the U.S. and its allies, which could be channeled to any particular area within a few hours.

Primary mission of General Kuter's air units in case of all out war would be to destroy the Communist bases and supporting fuel storage areas within their range in conjunction with the Seventh Fleet's 500 to 600 aircraft.

USAF Strength

Two U.S. Air Forces are stationed in the Far East. Bulk of the Fifth Air Force is in Japan, as are 65,000 of the 79,000 persons manning U.S. air bases in the Far East. Commanded by Lt. Gen. Frederic H. Smith, Jr., who concurrently heads all U.S. forces in Japan, the Fifth includes three wings of F-86 fighter-interceptors and one wing each of B-57 bombers, F-100 and F-84 fighter-bombers, and RB-66, RB-50 and RF-84F reconnaissance aircraft.

Fifth also has one wing each of F-100s and F-86Ds in Okinawa and a wing of F-86s in South Korea. Units of F-100s or B-57s will be constantly rotated to Korea now that the U.N. command has abrogated the Korean armistice stipulation banning introduction of new weapons into Korea.

The Thirteenth Air Force, based in the Philippines under Maj. Gen. John B. Ackerman, has one squadron of F-86s with a squadron of F-100s arriving in August. Air Task Force 13 of this Air Force exercises operational control over Fifth Air Force squadrons rotated to Formosa.

Southeast Asia Defense

As the prospective shipment of nuclear-capable F-100s indicates, the Thirteenth is expected to assume growing importance due to the easier movement of aircraft under the new command set-up. This will mean increased capability of fighting a limited war in Southeast Asia, whose defense will get more attention.

Other U.S. air units under the unified command include a squadron of F-86s each in Hawaii and Guam. Formerly, these two squadrons constituted the Seventh Air Force, with headquarters in Hawaii. But under the reorganization plan the Seventh has been abolished and its two units placed directly under General Kuter.

The USAF is at present training with Matador surface-to-surface guided missiles in Formosa. Only other guided missiles in the area are those of the Seventh Fleet, which is equipped with Regulus I surface-to-surface missiles and

Army's New Indians

Washington—U. S. Army, frequently accused of wandering off the reservation in the field of aviation, has rechristened all of its aircraft with Indian names. The goal, Army says, is to encourage the use of names instead of type and model designations. New Army designations include:

- **Bell H-13** ..... **"Sioux"**
- **Sikorsky H-19** ..... **"Chickasaw"**
- **Vertol H-21** ..... **"Shawnee"**
- **Hiller H-23** ..... **"Raven"**
- **Sikorsky H-34** ..... **"Choctaw"**
- **Sikorsky H-37** ..... **"Mojave"**
- **Bell H-40** ..... **"Iroquois"**
- **Cessna XH-41** ..... **"Seneca"**
- **Hiller Flying Platform** ..... **"Pawnee"**
- **Beech L-23** ..... **"Seminole"**
- **De Havilland DCH-4** ..... **"Caribou"**
- **Grumman higher performance observation aircraft** ..... **"Mohawk"**

Three standard Army aircraft, already carrying popular names, have been permitted to retain their old labels. They are the Cessna L-19 "Bird Dog," de Havilland L-20 "Beaver" and de Havilland U-1 "Otter."

Sidewinder and Sparrow air-to-air missiles, and will shortly get the surface-to-air Terrier.

The Falcon air-to-air missile will probably be part of the unified command's equipment. It is likely to be carried by the F-102, which is expected to see service in the Far East soon.

One difficulty is that Japan, though America's largest air base in the area, may balk at the storage of missiles on its soil due to popular abhorrence in this twice atom-bombed country of anything associated with atomic destruction.

Allied Strength

Actually, the Free World's airpower in the Pacific-Far East is not confined to the U. S. Air Force. The nations in the area under America's military tutelage now have 1,000 aircraft, mostly jets, while Australia, New Zealand, and Great Britain together are believed to have more than 500.

Ideally, U. S. officials would like to knit all these forces into a single command network. But this is recognized as politically impossible at this time, especially in view of anti-military sentiment in Japan and strained relations between Japan and South Korea and between Formosa and Great Britain, which recognizes Communist China.

Nevertheless, the U. S. program calls for gradual reduction of American air units in the Pacific-Far East as allied airpower in the area increase. Thus, by 1961, U. S. aircraft are expected to number only about 1,500 as against 2,500 to 3,000 operated by the countries America is now building up militarily.

Biggest buildup will be made in Japan, whose tactical air units will comprise more than 800 aircraft by 1961.

Philippine, South Korean and Thai air forces which now total 400 combat aircraft will nearly double. Formosa, which now has 350 aircraft, is not likely to get many more.

Simple acquisition of jet aircraft will not make effective air forces in these countries.

There is a severe shortage of pilots and technicians, as reflected in high accident rates.

JATO Boosts Hercules

Lockheed C-130 Hercules turboprop transport weighing over 80,000 lb. took off in between 400 and 500 ft. with assist of eight JATO bottles. Normal takeoff distance is 800 to 1,000 ft. Additional JATO tests are planned up to gross weights of 116,000 lb. and for rough field suitability. In troop movement (left), Hercules transported 104 persons, including 92 combat-equipped soldiers, 2,000 nautical miles in 8 hr., 5 min.

German Aviation Team Inspects U. S. Fighters

Bonn—German aviation team of seven civilians and three officers is in the U. S. to check fighter aircraft.

On the basis of their report, the German Air Force will place an order in the U. S., France or Britain to establish the nucleus of its air defense system.

Germany's experts have already inspected the English Electric P.1, Hawker Hunter and Saunders Roe SR/53 in England; Super Mystere, Trident and Mirage 3A in France. They are expected to pay particular attention to the Lockheed F-104 Starfighter, Convair F-102, Grumman F-11-1F Tiger and Republic's F-105.

According to present planning, the first air defense squadron will be operational towards the end of 1959 (AW July 8, p. 88). Final buildup will see 6 to 10 wings, 2 squadrons to a wing, 18 planes to a squadron or 200 to 400 fighter-interceptors in all.

Also for air defense, the Germans will obtain Nike missiles in the near future and an as yet unspecified low-height surface-to-air missile, possibly Hawk. Substantial orders for radar and communications equipment have already been placed in the U. S.

First post-war German airmen to form combat units, however, will be those attached to the tactical air force. First squadron will start assembling this October at Memmingen with 25 F-84Fs. By the end of next year, German Air Force expects to have 200 to 250 operational F-84Fs in their tactical air force. Final fighter-bomber strength of 300 to 400 divided into 12 to 16 squadrons is planned. To follow the F-84Fs, Germans are thinking of Dassault Etendard, Mirage or Baroudeur.

Also under tactical air force command will be a fighter-reconnaissance division of 180 planes, 108 of which are RF-84Fs, the remaining 72 a lightweight strike aircraft or a heavier one similar to the RF-105. Transport will be covered by 128 four-engine craft, chiefly the French Noratlas.

The German Air Force is still in an embryonic stage of 18,000 personnel, 15,000 are in the air training school, the others in materiel, ground, defense ministry and diplomatic posts. Number of qualified pilots is 100-odd.

To reach its final strength of 100,000 officers and airmen by 1962, the air force intends to graduate 1,000 cadets a year. Cadet school which began last Oct. 1, saw its first class of 266 pass out on March 31, with 90 ticketed for pilots' wings. Cadet school currently runs six months, preceded by three months in a training battalion, and followed by five months of flight or ground specialist school prior to commissioning.

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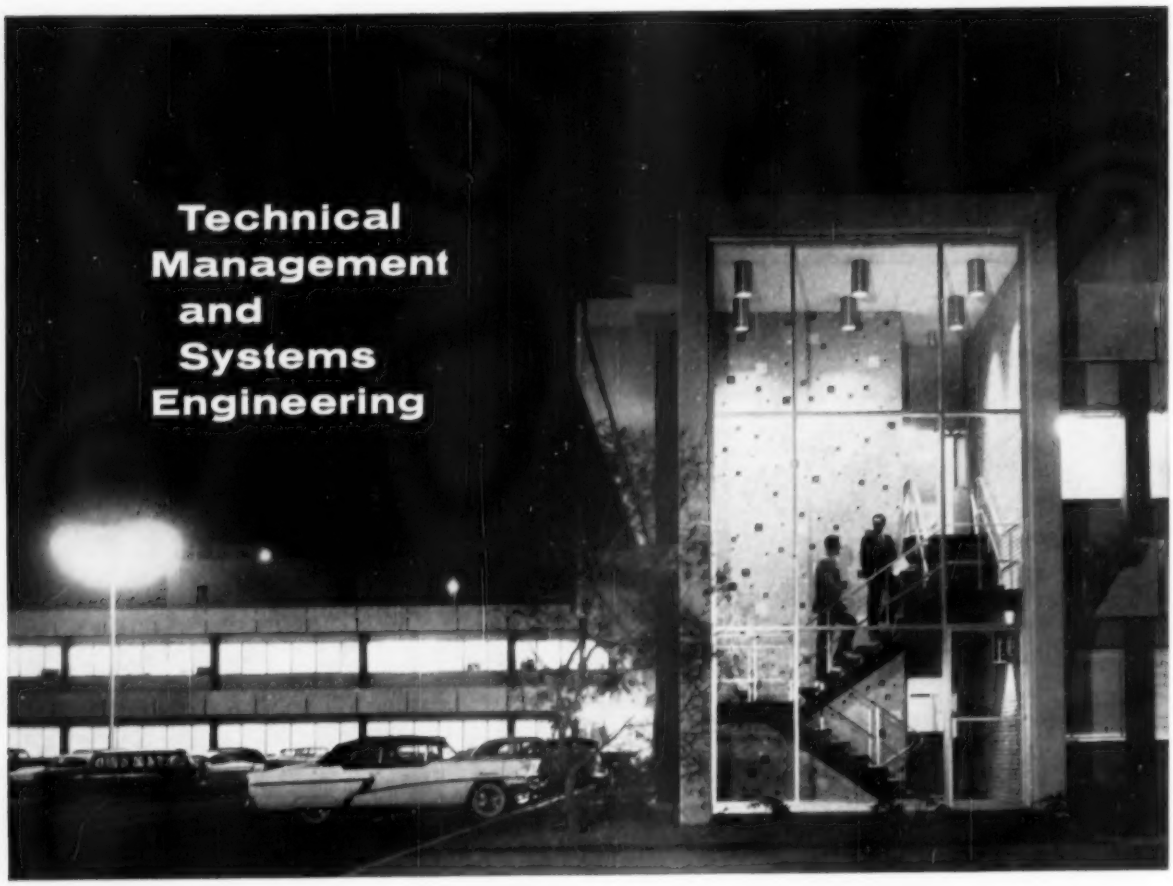

In systems engineering work, it is necessary to bring together a team that includes scientists and engineers of a wide range of technical specialties. In major weapons-systems projects, such teams will include hundreds of scientists and engineers.

But the assembly of a large group of scientists and engineers, no matter how capable they may be individually, does not of itself ensure good systems-engineering performance. The caliber of the project management has a major effect upon its technical accomplishment. It is not easy to coordinate the activities of large numbers of scientists and engineers so as not to stifle their creativeness on the one hand, nor to permit the various development sub-efforts to head toward mutually incompatible objectives on the other.

Of primary importance for good systems management is the philosophy underlying the selection of the supervisory personnel. The head of a technical activity should, first of all, be a competent scientist or engineer. A common mistake – nearly always fatal in systems work – is to fill such positions by non-technical men who have been trained only in management techniques. In the highly complex activities of major systems work, what is required is *technical management*, and of the two words, the word *technical* must never be overlooked.

In the selection of scientists and engineers for technical management, it is essential that the men chosen be broad in their training and approach. Each principal department head, for example, must have a good basic understanding of the technical facts of life of the other departments. When these people get together they need to speak a common language and understand each other's fields, so that proper decisions can be made on the many interrelated problems that come up. The higher the organizational responsibility of a technical manager, the more important this factor becomes.

The Ramo-Wooldridge Corporation is engaged almost entirely in systems work. Because of this, the company has assigned to scientists and engineers more dominant roles in the management and control of the business than is customary or necessary in most industrial organizations.

Scientists and engineers who are experienced in systems engineering work, or who have specialized in certain technical fields but have a broad interest in the interactions between their own specialties and other fields, are invited to explore openings at The Ramo-Wooldridge Corporation in:

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Court Rules Railroads Violate Antitrust Law

Washington—U. S. District Judge Joseph C. McGarraghy last week ruled that railroads violate antitrust laws by taking concerted action in setting rates for government shipments.

The ruling applied to a suit for treble damages of $45 million against 42 railroads earlier this year by the Aircoach Transport Assn., representing a number of non-scheduled airlines and now merged into the Independent Airlines Assn. (AW April 15, p. 25).

Judge McGarraghy declared that the concerted rate cut processes by the railroads are "illegal per se under the antitrust laws" and said he would sign an order enjoining the railroads from such practices. He left the amount of damages to be resolved by trial.

In the suit, the air carrier group charged the railroads with "illegal economic warfare" by allegedly offering rate reductions from 10% to 50% less than regular rates when competing with air carriers for military charter traffic. They also accused the railroad of charging military establishments the "maximum price allowable" when no airline competition is involved.

According to the suit, the railroads in 1953 replaced a traditional policy of offering a 10% discount on all military traffic with a spot rate procedure that enabled them to undercut airlines when competing in bids for military traffic.

In the ruling, the court found that the Interstate Commerce Commission does not have primary jurisdiction and has never granted immunity. It also found that railroads are not immunized by existing laws from antitrust requirements in connection with concerted rate quotations.

Railroad attorneys said the decision probably will be appealed. Biggest user of the reduced rate rail shipments is the Defense Department.

News Digest

Navy this week will attempt to establish a new transcontinental speed record by sending a Chance Vought F8U on a 2,450-mile flight between Los Angeles and New York. Pilot will be Marine Maj. J. H. Glenn. Navy says purpose of flight is "to test the sustained capability of the F8U at near maximum power over a long distance."

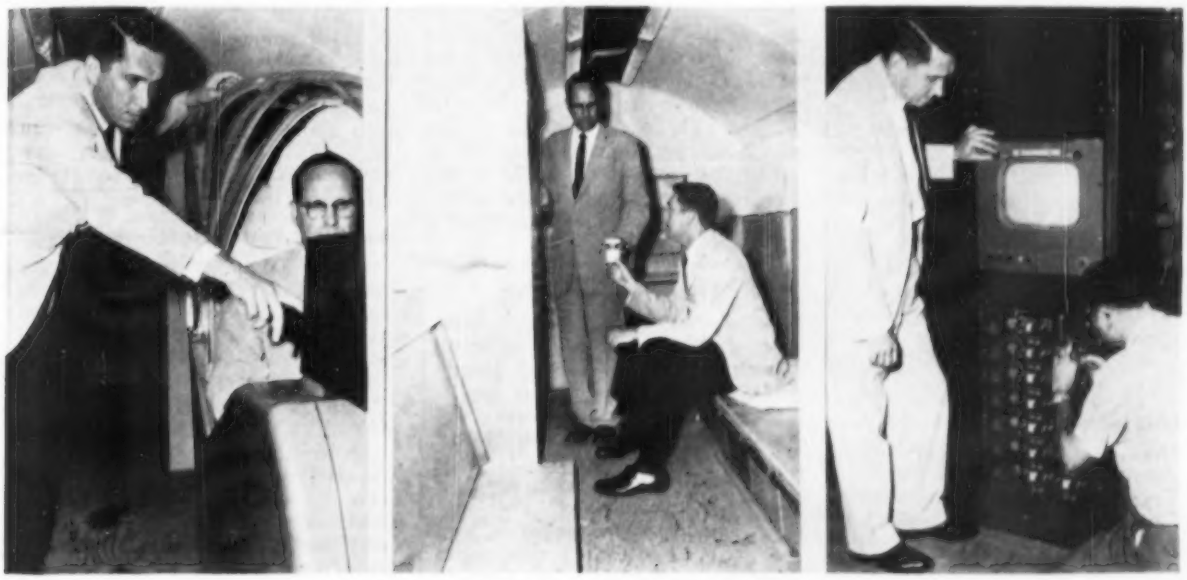
Army's first combat group to be equipped with the 200-mile-range Redstone missile will be activated on Sept. 9. The unit, designated the 40th Field Artillery Group, will be organized at Redstone Arsenal and assigned to the 3rd U.S. Army with headquarters in Atlanta. Group will be composed of 600 officers and men; 200 in the missile battalion, the remainder in the ordnance and engineer companies.

Transistor reportedly capable of operating at temperatures to 500C and of amplification at frequencies to 10,000 mc. will be announced by Raytheon Mfg. Co. Called a "Spacistor," it operates on a new principle involving acceleration of charge carriers in space-charge region by reverse-biasing of junction.

First Boeing 707 aft fuselage section built by Ryan has been shipped to Boeing. The 40-ft. section contains 36 windows, aft entry door and galley and two cargo doors. New contract of $16 million for a similar section of the Boeing KC-135 tanker have been received by Ryan, while production of the rearmost fuselage section has been transferred to another subcontractor.

Army orders for Bell H-13H helicopters now exceed 200 with the placement of an order for 42 last week. Three-place H-13H is powered by 260-hp. Lycoming VO-435 engine.

Short Bros. and Harland will fit its SB.5 variable wing research aircraft with a Bristol Orpheus engine, replacing the original Rolls-Royce Derwent. Additional power will enable the SB.5 to fly with a 69 degree sweepback and at a higher gross weight, according to the company.



Human Stresses on Long Flights

Fullscale mockup of a small flight station approximately the size of an automobile will be used this summer to confine five men for 120 hours in a new human factors research project at the Lockheed Marietta plant. Under contract for the Air Research and Development Command, Lockheed experts will study the stresses imposed by long-range flights, presumably in space vehicles and nuclear powered aircraft. The work is directed by the Biophysics Branch of USAF's Aero Medical Laboratory. Confined men will "fly" the airplane, operating dummy controls and simulating emergency and normal flight conditions. Ten crews will be used. For periods of almost a week, a crew will eat, sleep, work and relax in an area 17 ft. long, seven feet wide and less than six feet high.

Beacon Will Aid Florida Corridor Traffic

Airline aid installed for Wilmington-Palm Beach corridor, but Navy may still disrupt traffic.

By L. L. Doty

Washington—A high-powered homing beacon that will expedite navigation of airliners through the Wilmington, N. C.—Palm Beach, Fla., airway corridor was commissioned today, but airlines warned that traffic movement on the overwater cutoff will continue to be disrupted periodically so long as the Navy maintains unilateral control over the area.

Known as Control 1150, the route has been the subject of sharp controversy between the Navy and civil operators for more than two years. The struggle came to a head early this summer when the airlines charged that they were forced to discontinue use of the airway after less than four hours notice that the Navy would conduct exercises with its Second Fleet in the area between April 29 and May 2 (AW June 17, p. 25).

Earlier this year, the Air Line Pilots Assn. refused to operate through the corridor as the result of Navy attempts to narrow the corridor from 50 miles to 30 miles at its widest point (AW Feb. 18, p. 45). As a time-saving shortcut that avoids the devious inland bend of the coastal route between Wilmington and Palm Beach, Control 1150 is important to airline operations from the standpoints of economy and shorter schedules on the New York-Miami route. The corridor is used primarily by Eastern and National Airlines.

It was originally established by agreement between the Navy and the Civil Aeronautics Administration to permit operation of airline flights on the shortcut through the large warning areas off the eastern seaboard reserved by the Navy for fleet maneuvers.

Points of Contention

Here are the principle points of contention in the controversy:

• **Airlines charge they are forced** to circumvent use of Control 1150. Navy counters that, as in the case of the fleet exercises between April 29 and May 2, it did not request reservation of the airspace which encompasses air routes and altitudes normally flown by the civilian airlines. It added that altitudes between 6,000 ft. and 24,000 ft. were left open on Control 1150 for civil operators.

• **Airlines say that separation** of military and civil aircraft by Navy controlled radar during maneuvers does not give due regard to the safety of civilian aircraft since airline pilots are unable to communicate with Navy radar control units. They also argue that airspace is legally controllable only by the CAA. Navy contends that unilateral control by the military allows for safe efficient movement of both its interceptors and civilian aircraft in instrument weather and at night and is in accord with the terms of agreement with the International Civil Aviation Organization.

• **Airlines have bitterly opposed** the reservation of large sectors of airspace for military use (AW May 27, p. 40) and have objected strongly to the offshore use of airspace as warning areas by the Navy. Navy claims that, for budget reasons, it must conduct training in areas relatively close to shore in order to economize on ship fuel and training time. It adds that it also must hold maneuvers close to shore in order to utilize shore-based aircraft employed as targets.

• **Some airline officials contest** the legality of the designation of airspace outside the continental limits of the U.S. as warning areas by the Navy. Midway point of Control 1150 is about 150 statute miles off the coast of Florida. The Navy contends it does and must operate in all ocean and air areas of the world. However, it says that, even if economic factors permitted, it could not conduct maneuvers in the mid-Atlantic without avoiding civil air routes since a heavy concentration of airways throughout all ocean areas can be expected within a few years.

Route of Control 1150

Control 1150 is about 600 statute miles in length with a 10-mile-wide entrance point at both Wilmington and Palm Beach. Diamond shaped, Control 1150 widens to 50 miles at the midway point, known as the Gateway, where a low-frequency range from Jacksonville provides a check point.

The high-powered, non-directional homing beacon—HHW—was implemented at Wilmington on July 1 and has been flight checked by the CAA and the airlines for the past two weeks. A low-frequency range is located at Palm Beach.

Air Line Pilots Assn. now feels that the new navigational aid will permit more direct flights and prevent unintentional wandering toward the warning areas on either side of Control 1150 as may have been the case when Wilmington was equipped only with a low-frequency range.

It was for this reason that pilots refused to fly the corridor between Feb. 1 and Feb. 15 when the width at Gateway was cut to 30 miles. Pilots felt that navigational errors due to the weak signals of the two low-frequency range stations exposed their flights unnecessarily to military activity. Only after the CAA had negotiated with the Navy to widen the corridor again to 50 miles did the pilots consent to resume the over-water operation.

Airspace Panel Agreement

Latest agreement reached in the Airspace Panel of the Air Coordinating Committee calls for the 50 mile width including a 15 mile buffer-zone west of Gateway and a 35 mile zone to the east. Originally, the pattern consisted of a 25 mile protective zone on either side of Gateway.

While the pilots are satisfied with the HHW unit, they are not happy over the split control of traffic in the contested area and say "there should be only one air traffic control agency on any given airway."

Pilots demanded the wide corridor and the installation of an HHW unit as early as May 18, 1956, in a meeting with the CAA, Navy and the Air Transport Assn. At that time, they called for increased radar facilities along the coast and for the introduction of procedures that would give pilots prior knowl-

Hughes Hearing

New York—Civil Aeronautics Board began a hearing last week in its investigation of possible control by Howard Hughes of Northeast Airlines through his holdings in the Atlas Corp. Such control, in conjunction with Hughes' control of Trans World Airlines, would require approval under Section 408 of the Civil Aeronautics Act.

The inquiry centers around the exact nature of negotiations between Hughes and his representatives and Floyd B. Odlum, president of Atlas, which led to a merger between Atlas and RKO Pictures, under which Hughes became the largest single holder of Atlas common stock. About 8% of the Atlas portfolio consists of its majority holdings in Northeast.

edge of military activities in the area. They also suggested the formation of a committee represented by each agency to iron out air traffic control differences on the route.

According to one airline official, restrictions of operations on Control 1150 begin with warning notices issued by the Patrick AFB, Fla., to the Miami air route traffic control center which passes the information on to other centers along the East Coast.

Civil traffic on Control 1150 is jointly controlled by the Washington, Jacksonville and Miami centers. Notices of flight restrictions on Control 1150 are distributed by the CAA through Notices to Airmen.

Airlines charge this information seldom reaches them in sufficient time to reroute flights efficiently. One airline dispatcher told AVIATION WEEK, "We can never plan on the airway and we have a lack of confidence in its availability whether notices have been issued or not."

Navy Position

In a letter to AVIATION WEEK (July 8, p. 154), Assistant Navy Secretary Garrison Norton said restrictions on civil carriers are "imposed by the Civil Aeronautics Administration through its refusal to clear aircraft through the area in which the Navy was conducting training exercises."

During the naval exercises, the Navy established an air tunnel between 6,000 and 24,000 ft. on Control 1150 for a 27-hour period to permit operation of civil aircraft through the area and warned that maneuvers would be conducted within a 100-mile radius of Gateway.

The CAA refused to issue air traffic control clearances through the area during the period exercises were held despite the tunnel provisions.

Airlines operating through the southeastern sector of the U.S. claim that information concerning the maneuvers was received less than four hours before they began. They also accuse the Navy of failure to release the warning notices in sufficient time to readjust schedules and say that some flights were already routed via the corridor at the time the warning was received.

Navy Position

Navy insists that its only request for air reservation was for the area between the surface and 6,000 ft. and between 24,000 ft. and 45,000 ft. It adds that any requirement by the airlines to circumnavigate the Navy exercise area was "neither imposed nor desired by the Navy."

It concluded that, as a consequence, the problem is one for resolution between the ATA and the CAA, "the agency establishing the restriction."

Lake Central President Urges Passage of Guaranteed Loan Bill

Washington—Modernization of local service airlines equipment is more than an airline problem, Gwin Hicks, Lake Central Airlines president, told the Senate Commerce Committee last week. Hicks said modernization is urgently needed for the development of civil and military aviation around the world.

The Lake Central president appeared before the committee in support of the Guaranteed Loan Bill introduced to aid local service carriers acquire new equipment through government guaranteed loans. Airlines claim that the poor financial standing of local airlines now prevents them from acquiring the necessary financing without government aid. He told the committee:

"Let us consider the effect of new equipment upon the mobilization potential and for emergencies when speed and readiness can save many thousands of lives. It is widely known that the trunk airlines have committed hundreds of long-range, four-engine aircraft to the Civil Reserve Air Fleet. It is less known that an important shore-range role is left for the planes not in the CRAF under what is called the War Air Service Pattern, for re-allocation of commercial aircraft in war. Some of the modern equipment made possible by the pending bill may have to fill the gaps in the trunkline system after CRAF planes go for overseas duty. Others will fly where the need is greatest."

Hicks said the local and territorial airlines fleet includes about 250 multi-engine transports and close to 100 aircraft of other types—a fleet larger than that of the combined U.S. domestic airlines in World War II.

The trunk lines, he said, are now gearing for the jet age, while the local service carriers are faced with the problem of transporting people from the small communities to the jet hubs in planes manufactured 20 years ago.

G. Robert Henry, Bonanza Airlines executive vice president, told the committee that financing has not been arranged for more than nine of the Fairchild F-27 turboprop aircraft ordered by the local service carriers. Bonanza has three on order, but financing arrangements have not been completed.

Another witness before the committee was C. A. Myhre, Frontier Airlines president, who submitted a letter from a Denver bank which said in effect that passage of the Guaranteed Loan Bill would facilitate the obtainment of equipment financing for Frontier which otherwise might not be available.

Other legislation introduced to aid local and territorial airlines include the Capital Gains Bill and the Equipment Trust Bill. The Capital Gains Bill would allow airlines to set aside profits from the sale of equipment to be used in the purchase of new planes instead of the present policy of offsetting subsidy.

The Equipment Trust Bill would amend the Bankruptcy Act to permit lenders to take possession of aircraft and other equipment in the event of bankruptcy without being affected by other provisions of the act.

The Guaranteed Loan Bill was sponsored by the Civil Aeronautics Board and is supported by the Assn. of Local and Territorial Airlines. The Air Transport Assn. also supports the bill. The Equipment Trust Bill is backed by the Conference of Local Airlines, from which ALTA split (AW April 1, p. 38). No opposition has been expressed against either bill.

Hearings on the Guaranteed Loan and Capital Gains bills have been scheduled by the House Commerce Committee for this week.

Competition Blamed For Fare Boost Need

Washington—Multiple competition over basic routes is one of the primary reasons behind Eastern Air Lines needs for a passenger fare increase, T. F. Armstrong, EAL President, told CAB Hearing Examiner Ralph Wiser.

Armstrong, who appeared in support of the proposed 6% fare increase asked by seven trunk airlines, said decisions by the Board in the last two years have exposed 58% of Eastern's traffic potential to new competition. Even before this, he added, Eastern's routes already had been subjected to more competitive and duplicative route awards than the routes of any other carrier. Armstrong said that, as a result of the multiple competitive route awards, there has been a sharp reduction in the rate of Eastern's traffic growth.

In the past, he said, Eastern has been able to offset its rising costs to some extent by increasing traffic volumes. Now, however, traffic increases no longer afford an offset to rising costs. He told the Board:

"We have to call upon the Board to face the responsibility for this situation. We told the board of our equipment program and our plans for increasing our service pursuant thereto. Nevertheless, the Board found that additional services should be authorized."

More Women Travelling—Airlines Increase Promotions to Ladies

By Glenn Garrison

New York—Airlines are stepping up efforts to woo the ladies to their ticket counters. Particularly among the overseas carriers, new or expanded promotion and service programs are beamed specifically at the female market.

Everyone agrees that this market has been growing at a proportionately faster rate than the total air travel market—i.e., including men. Most airlines are convinced that changing travel habits make the women's market a more and more worth-while target for special efforts.

Both Pan American and Trans World Airlines estimate that more than half their transatlantic passengers now are women, and that this has only been so within the past few years. Furthermore, they believe the trend will continue. Foreign-flag airlines serving New York agree.

Lady Promoters

TWA in 1952 started a trend in airline women's promotion by creating "Mary Gordon," travel adviser-trade name for its special women's services. Mary's airline sisters now include Lady Sabena and her family of Mademoiselles Sabena; Sally Simpson of Scandinavian Airlines System; and Kaye L. Emerson of KLM Royal Dutch Airlines, who usually goes by her real name of Anika Burgard.

TWA says Mary Gordon was the "very first" in the field of special services to women travelers, but Pan American's Jane Kilbourne (real name) claims a first in women's promotion generally and says her airline was first in realizing the increasing potential of the market.

Most airline ladies promote air travel, and their own companies, by speaking to women's groups, narrating fashion shows, discussing travel in television interviews, demonstrating how to pack for a trip, appearing with special department store fashion promotions, and the like. Beyond these basic devices, their special services, and organizational approaches, vary considerably. Examples of how they are handled:

• **TWA has five Mary Gordons** operating in the United States, all under general sales division supervision with Janet Garlough heading the program from New York as director, women's department. The program began five years ago with one Mary Gordon. TWA's advertising campaigns feature the service and solicit inquiries to Mary Gordon. The ads draw as many as 6,000 mail responses a month, according to Miss Garlough.

A lot of the letters come from men.

A top puller has been an ad stressing tips on how to get ready for a trip to Europe. TWA also produces 12 leaflets in connection with its Mary Gordon services, with tips on such matters as international cooking, traveling alone, what to see and what to buy, how to plan a travel wardrobe. Special promotions have included Mary Gordon tours of Europe, special showings of fashions from points over TWA's international system.

• **Pan American's women's promotion** is handled entirely by Jane Kilbourne, who began her program in 1946. The airline buys no advertising space for the women's angle. Miss Kilbourne works through editorial tie-ins, press releases, special programs arranged through district sales managers.

She makes about six personal appearances a year—for instance, a week at a Seattle clothing store as travel adviser during a special promotion. Typically, this even drew editorial coverage in the local papers. Miss Kilbourne also works out contract arrangements with magazines which result in good publicity for Pan American.

Example: the April issue of "Seventeen" featured South American fashions, with the airline prominent editorially both in pictures and copy.

Miss Kilbourne hopes to see an expansion of Pan American's women's promotion activities, with additional representatives to cover women's clubs.

• **KLM** started its program in this country last December under its new director of women, Miss Burgard. She, like Miss Kilbourne, handles the whole show. The program consists mainly of contacting women's groups, speaking on subjects ranging from the status of women in various countries to best methods of packing for travel. Miss Burgard also follows the fashion show, TV appearance and press interview circuit, particularly in the 23 U.S. cities where KLM offices are located. The airline has a representative in Holland who also devotes her time to women's promotion.

KLM's transatlantic figures for the past two years, incidentally, show the male passenger still ascendant by a ratio of about 57%-39%. Remaining percentage is children.

• **Sabena's women's program,** three years old, features a new device in the "Lady Sabena Club." Crossing the Atlantic with Sabena entitles a woman to membership in the club, which includes among its benefits the entree to club rooms and lounges at airports and downtown locations in seven European cities. The airline's quarters in New York International Airport's new foreign airlines terminal, scheduled to open this year, will contain club rooms.

The members also receive various personal attention from "Mademoiselle Sabena" representatives stationed at most cities on KLM's international network. Irene Kondaks, who heads the Lady Sabena program in this country, reports a membership of 8,000. Miss Kondaks handles other U. S. women's promotion including the standard TV, fashion and packing demonstration items.

• **Northwest Orient Airlines** has just announced its new "Nora West" women's service, with Marilyn Christie as women's travel adviser to direct it. Northwest reports a 30% proportion of women among its passengers. Nora Wests will provide the usual travel talks, film showings, fashion and travel tips. The airline notes an increase in vacation air travel by women.

• **SAS** started its "Sally Ann Simpson" program in February, 1956, under the guidance of Jean Gammon. In addition to fashion, TV, women's club and similar promotion the airline's women's service will include a series of 42 shopping guides for individual countries on the SAS routes. One of the booklets already has been produced. Miss Gammon is writing a wardrobe planning book for lady air travelers.

Domestic Hard Sell

Compared to this intensified general promotion beamed at women by the international carriers, most domestic airlines so far are following more of a hard sell approach and testing the market on an individual prospect basis. Examples:

• **American Airlines** until a few months ago had only one women's representative, Mrs. Alexander Stevens, who handled the program for about six years. There are now women under American's district sales offices at Washington, Los Angeles, San Francisco, and Chicago, but there is no coordinated program. Mrs. Stevens operates chiefly by contacting the heads of various women's groups. For example, American handles all Girl Scout air transportation in the country, either by selling tickets to Scout conventions or by planning air travel by other carriers where American routes are not involved. The airline does no advertising directly to women. Its saleswomen are called special sales representatives rather than women's representatives.

• **United handles** its women's promotion on a divisional basis. Each

of the carrier's five divisions has one women's representative in its sales office. Their work, however, includes sales promotion generally as well as women's affairs, and they are called "manager of special events." Events include the ubiquitous fashion shows and radio and TV appearances.

While there is general agreement that the women's market is an increasingly important factor in airline travel, statistics to appraise it are not abundant. Some examples that hint at the scope of the market.

• **TWA ran a spot survey** of its transatlantic passengers last summer, found that women comprised 57% of the eastbound, 59% of the westbound traffic. Another spot survey in February showed 44.5% of eastbound passengers to be women, from which TWA concluded that it carried more men in winter, more women in summer. Domestically, women comprise about 44% of its passengers, TWA estimates.

• **U. S. Department of Commerce Survey** reported 1948 passport applicants were 106,951 male, 63,951 female. By 1955, women were catching up with 162,388 applicants compared to 171,896 male applicants.

• **Passport office** of the State Department reports that 56.3% of 1956 U.S. internal travelers were women. "Traveler" is defined as a person covered by a passport.

• **Port of New York Authority,** surveying overseas departures from New York International Airport, found about half of the American citizens were women. An earlier Port Authority survey of domestic passengers found about 30% women among departures from the three New York airports during 1956.

Why are women flying in proportionately greater numbers?

There are many factors, including:

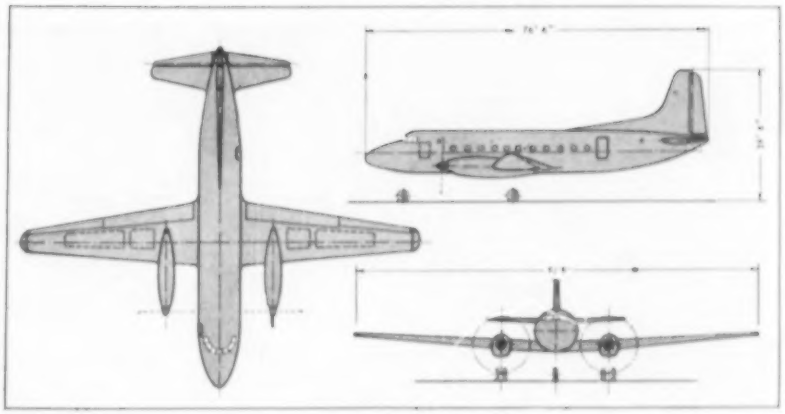
• **Most of the increase** in air travel is in the pleasure, rather than business, category. Only a small minority of female air passengers are business-bent, so increasing pleasure travel means proportionately increasing women riders.

• **Women are less reluctant** to travel alone. TWA estimates that a third of its women passengers to Europe are on their own. The airlines' special activities in promoting services for women probably have helped this trend.

• **More women are working** and have the money to travel. In 1940, 13.8 million women held jobs; last year, the figure was 21.2 million. Comparable increase in working men was from 40.6 million to 45.4 million.

• **As air travel** becomes increasingly accepted as safe and routine, more women are trying it.

Another reason for pitching sales promotion to women is their influence on the way the family budget, including vacation money, is spent.



Germans Plan Turboprop Liner

Germany is making its first postwar bid to enter the transport aircraft market with plans for a medium-range, 54-passenger transport powered by two Napier Eland turboprop engines.

The aircraft, designated the HFB-209, has gone through the first design stages and is being offered to the aviation market as either a short-haul, high-density airliner or as long-range executive type aircraft.

It will be built by Hamburger Flugzeugbau of Hamburg-Finken-Werder, Germany which has constructed no aircraft since the war but produced the four-engine, HA-139 seaplanes for Deutsche Lufthansa's transatlantic mail service during the 1930s.

Although the company has designed the HFB-209 with Napier Eland N.E1.6 turboprop engines rated at 3,500 shp. equipped with four-bladed reversible propellers, the Allison 501-D 13 and Rolls-Royce Tyne are also suggested as possible powerplants.

Here are the proposed transport's operating characteristics and specifications:

• **Configuration** calls for a 48 to 54 passenger capacity on stage lengths of 1,250-miles or less. All compartments of the fuselage including cargo holds are pressurized for flights of up to 25,000 ft. altitude. Fuselage is 76 ft., 6 in. in length. Cabin dimensions are 54½ ft. in length; and 9.38 ft. in width. Inside height is slightly over six and one-half ft., floor area is 47 sq. ft. Three baggage compartments have a total capacity of 402 cubic ft.

• **Low wing is built** on a two spar system with integral fuel tanks with a total capacity of 1,170 gal. located between the spars in each of the detachable outer wing sections. Wing span is 93 ft., eight inches, wing area is 963 ft., the aspect ratio, is 9.12.

• **Gross takeoff weight** is 45,080 lb. with a disposable load including crew, fuel, passengers and freight of 21,030 lb.

• **Cruising speed at 20,000 ft.** is 277 kt.; rate of climb at sea level is 2,260 ft. per minute. Service ceiling is 34,800 ft. Takeoff distance is 1,850 ft. Block speed is 238 kt.

According to the company, the aircraft, equipped with the Allison 501-D 13 turboprops, will have a cruising speed of 308 knots. Rate of climb will increase to 2,600 ft. per minute and the service ceiling will be raised to 36,400 ft. Block speed of this version will be 271 kt.

CAB Office Complaint Cites Pan American

Washington—Civil Aeronautics Board compliance office has issued a complaint against Pan American World Airways charging the airline with "unfair methods of competition in air transportation and tariff violations."

In a petition for enforcement, the compliance office said that, based upon information gathered during an informal investigation, Pan American apparently violated the Civil Aeronautics Act through payment of excessive or improper commissions to its agents. The office also contends that the airline charged less compensation for cargo transportation than the current effective tariff.

According to the CAB staff, Pan American has, since Jan. 1, 1956, and earlier, instructed or permitted various travel agents to earn or retain 10% commissions on sales of roundtrip first-class and tourist air transportation instead of the usual 7% on roundtrip first-class and tourist fares and 10% on authorized tours.

The staff also charges that Pan American has accepted from a New York shipper cargo at rates based upon actual weight when the dimensional weight rule, which provides for a higher tariff, was applicable.

Three B-52s at altitude. More than 1400 B-52s and B-47s have been built by Boeing.

Boeing has built more long-range, multi-engine jet aircraft than any other company in the world.

The 707 jetliner—test-flown over 2½ years—will bring you all of the advantages of this Boeing experience with jet aircraft.

BOEING 707

These airlines have already ordered 707s: AIR FRANCE • AIR INDIA • AMERICAN • B.O.A.C. BRANIFF • CONTINENTAL • LUFTHANSA • PAN AMERICAN • QANTAS • SABENA • TWA

North Central Wins Chicago-Duluth Route

Washington—North Central Airlines last week was authorized to provide non-stop service between Duluth and Chicago by the Civil Aeronautics Board.

The Board said it has tentatively voted to grant North Central's application to fly non-stop between the two cities or to make one stop on the route at Madison or two stops at Milwaukee and Green Bay.

Northwest Airlines' authority to serve Duluth was canceled.

The Board also announced it will approve North Central's application to extend its service eastward from Duluth to Saulte Ste. Marie via Ironwood, Hancock-Houghton and Marquette, Michigan.

A proposal by Northwest Airlines to operate an equipment interchange between the two airlines via Minneapolis was turned down by the Board.

Hal N. Carr, North Central's president, said the airline will inaugurate the Chicago nonstop service within 60 days after the final decision is issued which probably will be next month.

At the present, the airline is required to make a minimum of four stops over the Duluth-Chicago route and two stops between Duluth and Madison. The Board ruling will require that intermediate points which are overflown in the new nonstop service pattern must have a minimum service of two daily round trips.

Northwest's certificate to operate service between Duluth and Minneapolis was suspended by the Board in 1951 when North Central was authorized to serve the route.

Airline Pilot Reports Near Collision With Jet

Pilot of a United Air Lines DC-6 recently avoided a near collision with a jet plane over Oxnard, Calif., by pulling the airliner into a steep climb.

Sudden maneuver threw many of the 37 passengers out of their seats, but only two required medical attention.

DC-6 was piloted by Capt. C. H. Thompson.

The jet was not identified.

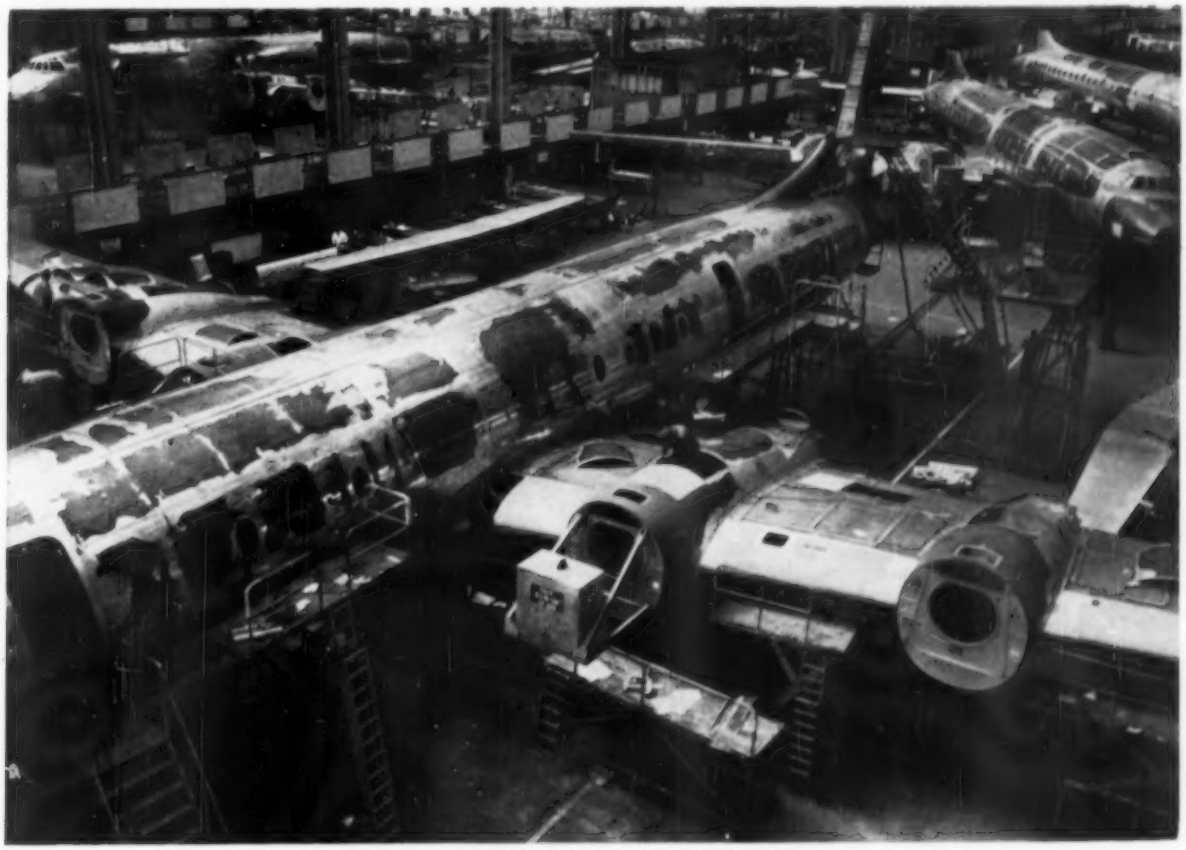
SHORTLINES

► **American Airlines** flew 765,000 passengers 510 million passenger-miles during June to become the first airline to fly more than a half-billion passenger miles.

► **Aerovias Venezolanas,** S. A., Avensa, has ordered five turboprop Fairchild F-27 aircraft to be used on connecting service for Avensa's Miami-Jamaica-Caracas run. The airline has been awarded a $1.2 million credit grant by the Export-Import Bank.

► **Transatlantic Airlines** proposing new class of tourist flight scheduled to begin next April have adopted the term "T-34" to designate the proposed service. The "T" indicates the tourist character of the service; "34" stands for the suggested distance in inches between seats. The present distances between seats are generally 38 inches.

► **Southern Airways** flew 105,405 passengers 18,142,000 passenger-miles dur-



Northeast's Britannias in Production

Second and third Britannias for Northeast Airlines on the production line at Short Brothers and Harland in Belfast will fly late this year. Fourth and fifth aircraft will fly early in 1958. First Britannia for Northeast has been delivered to Bristol for fitting out and certification.

SUD-AVIATION
CARAVELLE

ROLLS-ROYCE
AVON
TURBO JETS

ROLLS-ROYCE LIMITED, ENGLAND, SCOTLAND, CANADA, AUSTRALIA

ing the first six months of the year, a 16.6% increase in both categories over the same period of 1956. During June, the carrier flew 19,500 passengers 3,380,000 passenger-miles, an increase of 20% for both categories over June of last year.

► **United Airlines** plans to file for a 10% increase in its air freight rates to become effective Sept. 1, subject to Civil Aeronautics Board approval. The new rates would not apply to nursery items such as cut flowers, shrubs and roots and decorative woods, which would be raised only 5%.

► **Air France** will fly a pilgrimage to the shrine of Lourdes, France, on a tour organized by the Catholic Travel Office of Washington. The tour, sponsored by Edward Cardinal Mooney, Archbishop of Detroit, will leave New York on Sept. 26, spend a week in Lourdes, fly to Paris on the morning of Oct. 2 and depart that evening, arriving in New York the next morning. Price of the tour is $695.

► **North Central Airlines** established a new local airlines monthly passenger record by carrying 63,451 persons during June. The previous industry record was 56,467 passengers set by North Central last August. During the first six months of 1957, North Central carried 304,893 passengers, a 19% gain over the same period of last year.

► **Trans-Canada Air Lines** has begun the first nonstop transcontinental service in Canada by linking Toronto and Vancouver with Lockheed Super Constellations. The service is connected with New York by TCA.

► **Allegheny Airlines** set a new monthly record by flying 7,141,429 passenger-miles during June. In the first half of 1957, Allegheny flew 29,550,000 passenger-miles, an increase of 17.6% over the same period in 1956.

► **British Overseas Airways** will serve California champagne on all flights over U.S. territory, replacing French wines and champagne previously served.

► **Douglas Aircraft Co.** will begin deliveries of four models of the four engined Douglas DC-6A to Loide Aero Nacional of Brazil during the third quarter of 1958. Approval of two bank credits totaling $4,295,000 by the Export-Import Bank paved the way for the sale. The aircraft will be equipped for operation as combination cargo and passenger airliners featuring ready adjustment of the interior space to accommodate the varying relative volume of passenger and cargo traffic.

AIRLINE OBSERVER

► Look for Canadian Pacific Airlines to be given an opportunity to compete on east-west domestic routes against Trans-Canada Air Lines. Canada's new ruling party, the first Conservative government in 22 years, is expected to open the nation's airways to CPA which presently operates domestic routes only on a north-south basis in addition to its global international routes.

► **New York Airways late this year will ask helicopter manufacturers here and abroad to submit bids on a 25-passenger, two-or-three turbine engine airline helicopter. NYA has been working with other civil helicopter operators to develop a block of orders of sufficient size to make it worthwhile for manufacturers to proceed with the development of a new design. General Electric's T58, which is expected to go into production in 1958, appears to be leading contender as powerplant for the new helicopter wanted by NYA.**

► International Air Transport Assn. will refer the issue of transferring its headquarters from Montreal to Geneva to the association's general assembly which will meet in Madrid on Sept. 10. Plans to move result from demands by European airlines for a headquarters closer to their bases of operation.

► **Flying Tiger Line has received a $9 million contract from the Military Air Transport Service for the transportation of military personnel and freight between the U.S. and Japan. The six-month contract is renewable on performance and can be expanded up to the fleet capacity of the airline, or approximately $18 million. Initially, the airline has assigned three of its fleet of 12 Lockheed 1049H Constellations to the Pacific airlift but expects to increase the number to six during the next two months to accommodate MATS traffic demand.**

► Scheduled helicopter operations between Dallas and Ft. Worth were inaugurated by Helix Air Transport last week with an air parcel service between downtown heliports in the two Texas cities. Helix will operate three roundtrip flights a day with Bell 47-H equipment. The carrier has an application on file with Civil Aeronautics Board for a non-subsidy passenger, cargo and mail certificate, and its scheduled air parcel service will provide experience which will be valuable if Helix decides to go into passenger operations.

► **Civil Aeronautics Board has set final procedural steps in the Suspended Passenger Fare Increase Investigation with briefs due on July 24 and oral arguments scheduled for July 31.**

► United Airlines today began a joint air-truck freight service with Consolidated Freightways to provide air cargo service to shippers located in areas which do not have direct air service. The system will cover more than 900 cities in 16 states regularly served by Consolidated.

► **Civil Aeronautics Administration has proposed new runway layouts that will permit transport aircraft to turn off runways 30 to 45 seconds after touch-down. Taxiways will be oriented at an angle of 30 degrees to the runway under the new layout designs with a series of taxiway exits to accommodate both short and long landing flareouts. The layouts have been developed as standards by the CAA for use in the Federal Airport Aid Program.**

► Elwood Quesada, newly appointed special assistant to the president for aviation facilities, made a survey tour last week of the Civil Aeronautics Administration's Technical Development Center in Indianapolis accompanied by Assistant Commerce Secretary Louis Rothschild and CAA Deputy Administrator William Davis. At the same time, 10 CAA officials including Administrator James Pyle met with representatives of the Canadian Department of Transportation in Ottawa to review airways and navigational aid problems of the two countries.

THE FLIGHT HEARD 'ROUND THE WORLD

Recently three B-52 bombers flew around the world in 45 hours and 19 minutes. They were only specks in the vastness of the sky, yet they were in voice-contact every mile of the way—with SAC headquarters in Omaha, with each other, with bases along the route and with the KC-97 tankers that refueled them in the air.

Their speed-of-light contact was the AN/ARC-21 liaison communications set in each of the ships. This is a long-range, pressurized, high-altitude airborne system, capable of world-wide communications. It may be operated by the pilot, so no radio operator is needed. It is characterized by minimum training requirements, simplified maintenance, high reliability, positive channel selection —with a choice of any 20 of 44,000 frequencies.

In this as in other ways, RCA serves our Nation's armed forces. RCA scientists and engineers are constantly creating, designing and producing new and better electronic systems and equipment.

RCA Tmk(s) ®

RADIO CORPORATION of AMERICA

DEFENSE ELECTRONIC PRODUCTS — CAMDEN, N. J.

Airline Traffic — May, 1957

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	668,367	434,388	65 4	1,782,942	530,913	7,658,555	51,760,341	58 6
Braniff	172,932	72,787	59 2	278,221	81,501	547,906	7,896,963	48 9
Capital	345,490	133,052	57 9	457,353	119,435	454,801	13,758,834	46 5
Continental	69,609	29,403	49 8	94,937	31,731	164,423	3,115,385	42 0
Delta	226,215	108,409	60 4	355,634	140,950	858,718	11,803,114	57 2
Eastern	652,279	352,316	56 31	911,380	395,000	1,700,220	36,991,613	42 06
National	110,104	66,488	57 6	246,367	47,724	533,994	7,271,633	49 9
Northeast	56,073	14,844	54 9	24,187	15,043	62,324	1,520,672	40 9
Northwest	116,467	79,769	54 3	452,155	170,085	888,506	9,167,872	48 5
Trans World	384,665	291,298	65 1	1,057,434	363,623	2,727,702	32,075,078	58 0
United	525,513	383,435	62 7	2,447,664	415,024	5,356,070	45,060,495	55 1
Western	109,774	53,187	58 7	248,350	69,885	277,798	5,689,693	54 5
INTERNATIONAL								
American	10,941	7,379	51 5	16,036	335	303,751	1,103,549	58 6
Braniff	3,278	7,331	51 6	15,890	.....	80,214	898,201	48 6
Caribbean-Atlantic	17,355	1,206	51 58	1,760	.....	2,843	130,567	56 44
Delta	5,655	6,735	59 9	6,953	.....	56,874	813,214	52 8
Eastern	25,656	33,056	65 48	82,555	.....	66,733	3,549,701	42 60
National	5,830	3,903	37 2	5,485	4,211	35,647	451,887	37 2
Northwest	10,510	21,515	51 2	1,022,939	16,136	718,608	4,050,880	64 3
Pan American								
Alaska	6,628	7,263	56 1	45,087	.....	281,129	1,059,617	49 1
Atlantic	98,606	139,982	68 0	1,115,924	.....	1,994,352	17,804,878	63 2
Latin America	92,069	98,409	61 5	404,802	.....	3,630,105	13,517,914	59 6
Pacific	22,781	91,370	71 5	978,189	.....	1,458,163	11,956,412	64 5
Panagra	11,662	13,173	52 5	64,522	.....	378,702	1,869,823	55 6
Trans World	23,275	57,928	71 5	838,742	.....	738,087	7,648,643	73 4
United	6,968	17,471	63 2	105,562	.....	81,211	1,978,961	57 6
LOCAL SERVICE								
Allegheny	40,791	6,798	49 5	9,213	13,163	19,866	691,090	45 5
Bonanza	11,699	2,555	43 4	4,370	2,054	7,676	258,013	42 1
Central	10,718	2,086	35 0	3,800	1,675	7,801	213,328	31 3
Frontier	17,396	4,691	46 1	17,223	7,602	73,386	548,336	56 6
Lake Central*	.....	.....	.....	.....	.....	.....	.....	.....
Mohawk*	.....	.....	.....	.....	.....	.....	.....	.....
North Central	54,458	8,883	48 9	21,700	23,616	.....	893,861	49 2
Ozark	36,090	5,999	41 5	11,484	13,610	18,937	617,170	43 3
Piedmont	37,380	7,713	53 7	14,685	7,059	21,242	782,815	53 5
Southern	19,142	3,356	37 8	9,996	8,875	.....	339,974	37 1
Southwest	27,900	5,926	51 4	9,683	4,542	8,004	587,354	49 7
Trans-Texas	21,389	4,799	36 6	14,742	6,518	27,181	506,214	37 0
West Coast	22,720	3,965	48 99	3,860	2,260	6,692	391,104	46 33
HAWAIIAN								
Hawaiian	29,337	4,444	55 6	4,563	.....	118,476	517,562	57 3
Trans-Pacific*	.....	.....	.....	.....	.....	.....	.....	.....
CARGO LINES								
Aerovias sud Americana	.....	.....	.....	.....	.....	719,494	719,414	76 8
Flying Tiger	8,339	45,636	98 9	45,243	18,050	7,168,646	11,795,583	86 1
Riddle*	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western	2,703	16,610	100	.....	.....	1,956,558	3,617,670	85 8
Slick	6,956	25,296	98 35	94,974	33,854	4,702,270	7,423,690	78 01
HELICOPTER								
Chicago Helicopter	3,709	54 8	33 0	2,742 3	.....	.....	7,989 1	34 7
Los Angeles Airways	3,370	102	52 57	4,764	1,525	.....	15,606	58 26
New York Airways	6,981	126	38 3	2,252†	1,262	659	16,238	41 3
ALASKA								
Alaska Airlines	323	494	15 2	12,427	.....	192,752	258,769	38 8
Alaska Coastal	4,725	420	61 8	4,557	.....	3,835	51,215	62 3
Cordova	2,004	599	48 2	3,539	.....	227,442	291,342	48 2
Ellis	5,319	347	58 4	1,859	.....	2,988	40,212	67 8
Pacific Northern	9,588	9,240	55 8	87,869	.....	300,794	1,390,136	63 1

*Not available.
†Mail transferred in bulk.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

"Bernie" Fenwick, outside Friendship International Airport's Terminal Building. Directly behind him is a Constellation operated by Eastern Airlines, one of Pan-Maryland's airline customers.

"There's no ceiling on success when you fly with Shell!"

says G. B. Fenwick, Jr., President of Pan-Maryland Airways. P-M boosted its gallonage fiftyfold in six years as a Shell Aviation Dealer at Friendship International Airport, Baltimore

It's no wonder Bernie Fenwick is happy Pan-Maryland teamed up with Shell in April 1951. At that time, one truck was more than enough to handle their business. Three months later, thanks to Shell's help, they began making into-plane deliveries to the airlines.

Today, Pan-Maryland has 13 trucks busy fueling and servicing the airlines, private airplanes, jet fighters of the National Guard, police department aircraft, helicopters, military

and government-owned aircraft and dozens of corporate aircraft.

"We've got an extremely diversified operation here," says Bernie. "Pan-Maryland handles everything from Cubs to F4D Navy jets—from Mites to B-52's.

"Consequently, we handle the complete line of Shell Aviation Fuels, including Shell Turbine Fuels for jet planes and commercial turboprop airplanes.

"Shell also provides us with a full line of AeroShell lubricants, fluids and greases to fit our customers' needs. What's more, we get up-to-date technical advice from our Shell representative who's always at our service."

When Bernie talks about the services Pan-Maryland gives its customers, he emphasizes that delays are almost nonexistent. All pilots have schedules to meet and what they want most of all is fast, efficient, on-schedule service.

A "Customer's Service Report" is mailed to every flier who stops at the field. It invites comments and criticism of service, workmanship and courtesy. Replies like "Best service I've ever gotten—anywhere," "Excellent in every way," "Keep up the good work," are received every week from all over the country.

Bernie points out that their CAA Certified Repair Station is going to be finer than ever. A big new hangar will be completed soon and he plans a Class 4 shop there, with service crews qualified to work on every type of plane.

Other plans for the future include branching out into airline ramp service, setting up an aircraft sales department, building more hangars *and boosting gallonage still further.*

"After all," says Bernie Fenwick, "the sky's the limit with Shell."

Private planes get first-class treatment, too. Every civilian pilot who uses the field receives a "Customer's Service Report" which requests suggestions for improving service.

The Boeing 707 jet transport is fueled by Pan-Maryland with Shell fuel at Friendship International Airport after its recent record 3-hour, 48-minute transcontinental flight.

Bernie discusses plans for future expansion with Col. J. Colonna, Airport Director.

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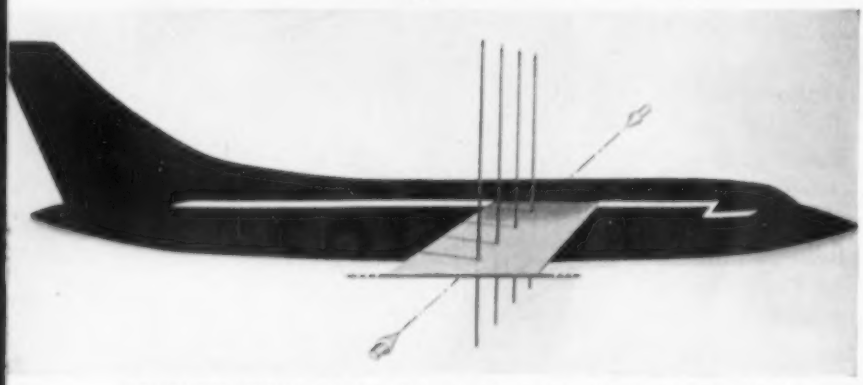
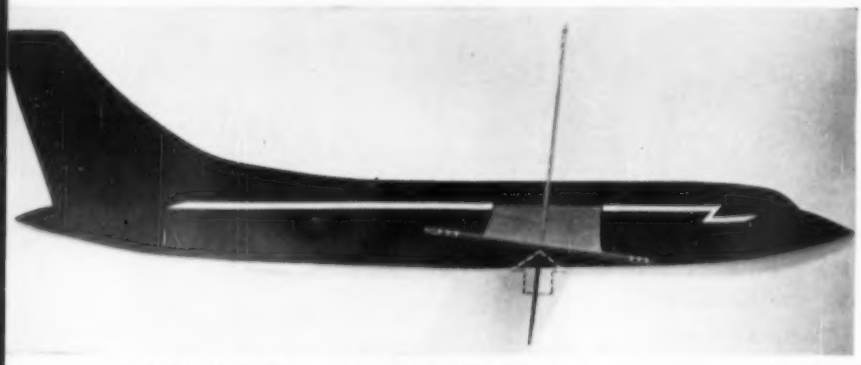
M-W Wings Sidestep Drawback of Sweep

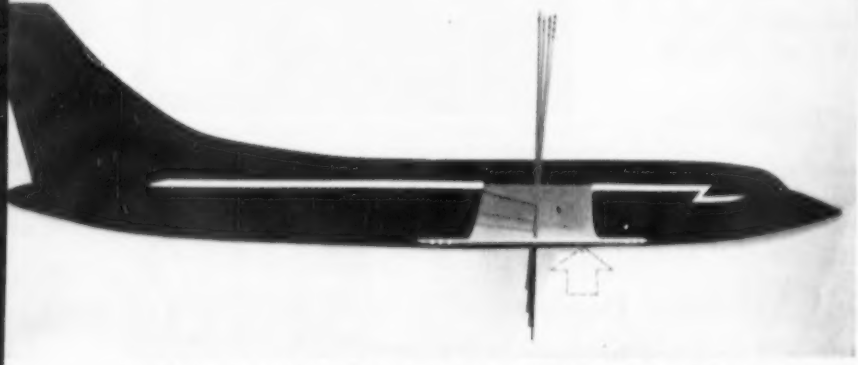
J. S. Butz, Jr.



DEMONSTRATION model to illustrate effect of bending and torsion loads on a sweptback wing is shown in no-load position. Long bar on wing tip emphasizes its angle of incidence. Columns extend through wing's elastic or twisting axis (arrows), so that wing twist will be shown by relative movement of the columns.



PURE bending load (arrow) acts through the elastic axis causing no wing twist. This is shown by camera angle along the elastic axis with the columns lined up under load. However, incidence of the wing tip is reduced causing loss of lift in that region.



TYPICAL torsion load acts ahead of elastic axis. Wing twist indicated by the columns tends to increase the angle of incidence and counteract effect of the bending load. It is difficult in practice for torsion load to overcome loss of incidence due to bending.

New York—Two promising though somewhat unfamiliar wings having M and W shapes are being tested in the U.S. for use on large, heavy transports and bombers designed to cruise at supersonic speeds.

The M wing sweeps forward on the inboard panels and back on the outboard; the sweep is exactly the opposite for the W wing. Basic idea is to retain the drag benefits of sweep while eliminating the aeroelastic problem which is the most serious drawback of a swept wing.

Ideal Shape

Delta, swept and straight wing planforms have been successfully used on a variety of supersonic aircraft to perform a number of specific attack and interception missions for the military. Disadvantages inherent in each prevent designers from agreeing on an ideal shape, and are such that all three may be passed over for very large planes operating at high altitudes and supersonic Mach numbers.

The story of the original idea of these wings is a familiar one. The Germans suggested and wind tunnel tested M and W wings in the early 1940s when they were years ahead of the rest of the world in transonic and supersonic aerodynamics.

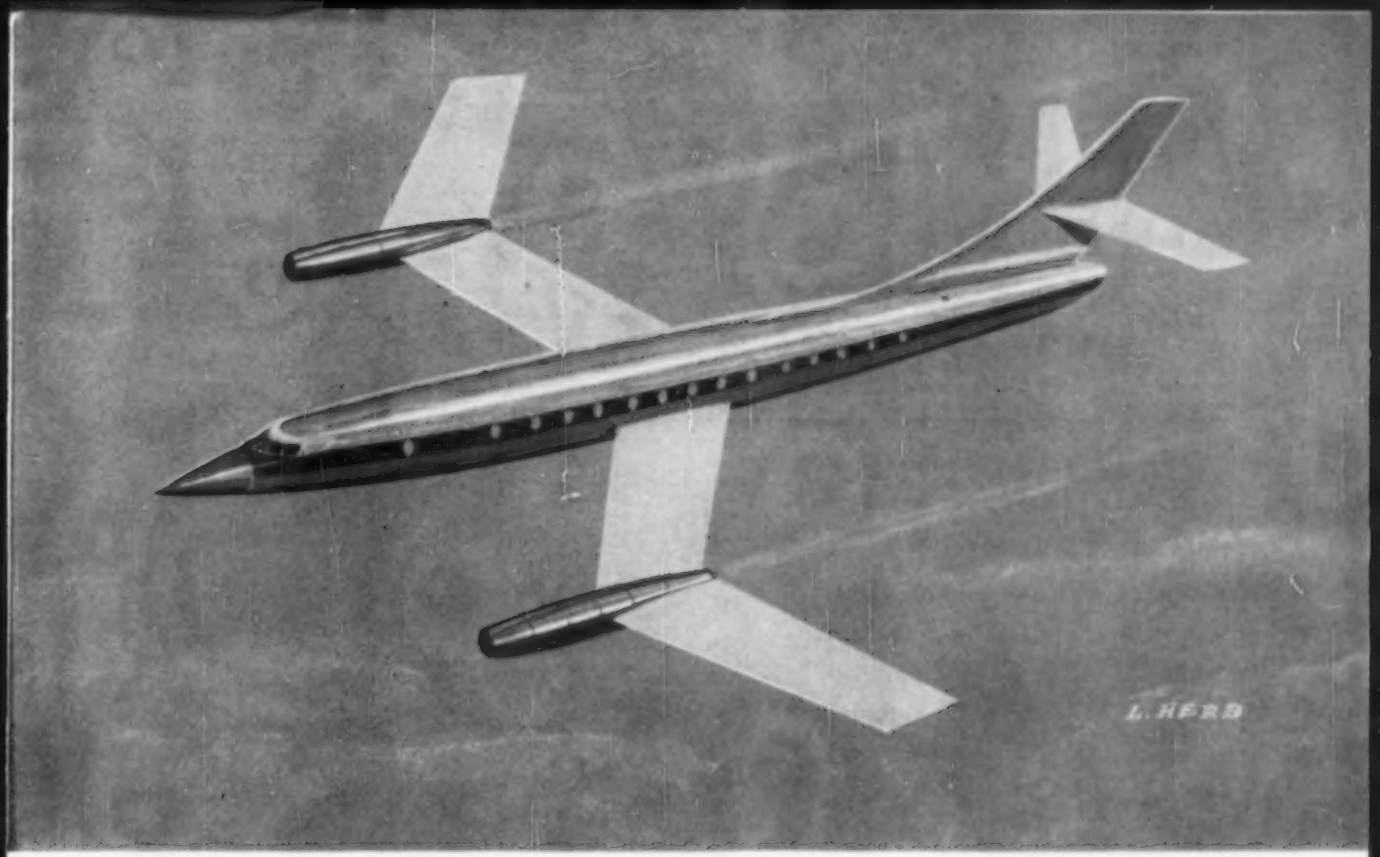
NACA initiated work on these wings in this country following a 1948 memorandum by R. V. Rhode of the Langley Laboratory. The problems of swept wings were more completely defined at this time and Rhode showed there were considerable structural possibilities in M and W wings, contradicting previous skepticism of their soundness.

Drag Question

Earlier objections to the wings also emphasized the poor drag qualities of the juncture of the swept panels. However, test work was begun on the strength of the aeroelastic potential. NACA is still working with M & W wings and much of the current interest centers around their use with area rule and other means of reducing the drag of wing-body combinations.

If transport cruise speeds continue to increase at the same rate they have for the last 10 years, then a 1,000 mph. (approx. Mach 1.5) jetliner will be flying around 1968.

Estimates of what the most economical transport in this class will be like



M-WINGED configuration that meets general requirements for transport with supersonic cruise speed. M wing is superior to simple swept wing in aeroelastic and stability characteristics.

have been made by R. T. Jones of the NACA. It will probably have a wing loading similar to present day transports, with comparable landing speeds, though it will fly at much greater altitudes where these wing loadings are most economical.

Reduced air density at this altitude means the structure would have to be stressed only for a sea-level cruise speed of 300 mph.

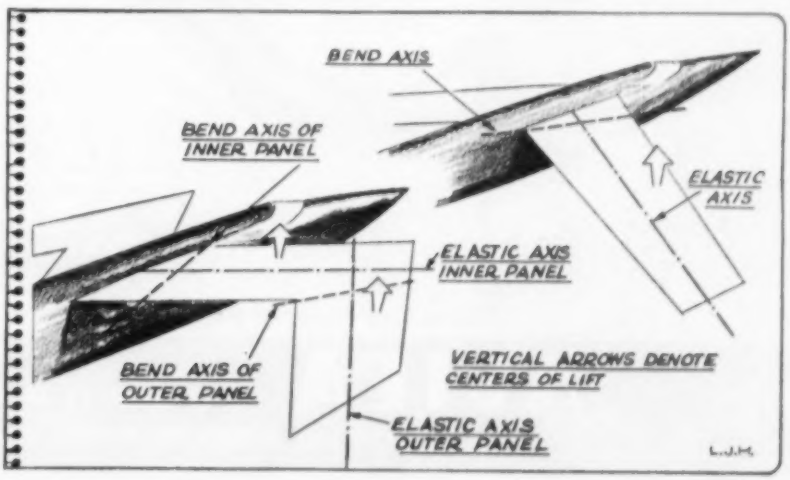
Aerodynamic heating would also be negligible under these conditions. The aircraft would have to be carefully restricted in its performance and maneuvers at lower altitudes where the airloads would be much greater than at cruise height.

As far as the wing is concerned, Jones' most important point is that the relative sizes of the fuselage and wing will remain much as they are on current aircraft.

The wing will also continue to be long and narrow with high aspect ratio, for supersonic as well as subsonic theory indicates that this is best for good cruise performance when the wing is contributing to the support of the aircraft.

This requirement for a long narrow wing is the one which makes use of current wing shapes difficult on the supersonic transport.

- **Delta wing** becomes inordinately large when it is given a wide span and high aspect ratio.
- **Straight wing** is restricted to a short span when it is thin enough to have low supersonic drag. This is because torsional strength decreases rapidly as the wing thickness decreases, introducing



SKETCHES show location of bending and elastic (twisting) axes on swept wing and M wing. Inner panel of M wing acts as simple swept-forward wing which experiences increase in incidence from bending load due to lift. This can be visualized by reversing the wind direction in the middle photo on the facing page. Here bending load gives the opposite effect of lift on sweptback wing. On the M wing the increase in incidence on the sweptforward section is counteracted by the outer panel lift which gives the inner panel a nose-down twist. This is the heart of M and W wing theory which the NACA feels will almost eliminate the adverse aeroelastic effects of swept wings.

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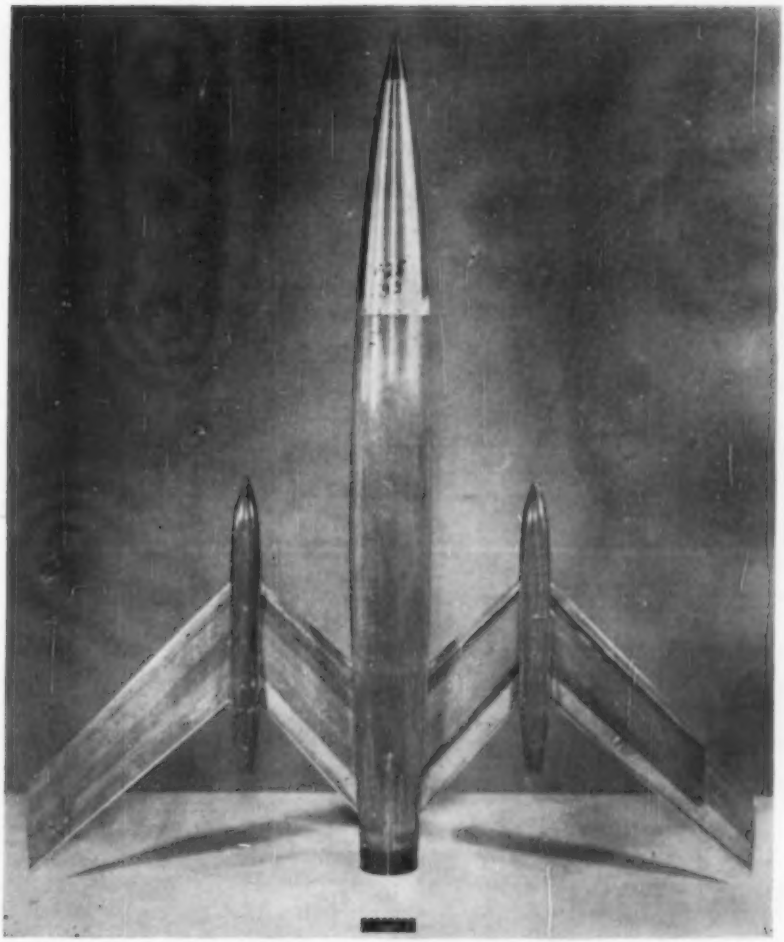


MACH 1.4 rocket model of M wing planform is used to obtain supersonic data. This configuration has relatively short span sweptforward panel, engine nacelles at junctures.

serious aeroelastic and flutter problems.

• **Swept wing** has formidable aeroelastic problems.

Incidence of the swept wing tip is reduced when the wing experiences pure bending. This results in a loss of lift at the tip, and the center of lift then moves inboard on the wing and forward with respect to the airplane's CG.

Cause of Instability

On a long span swept wing this forward movement of the lift force can easily cause a pitching-up moment larger than a normal size horizontal tail can overcome, thereby making the aircraft unstable. The effect of torsional load on the wing is shown in the illustrations. This type of load tends to counteract the loss of incidence due to bending.

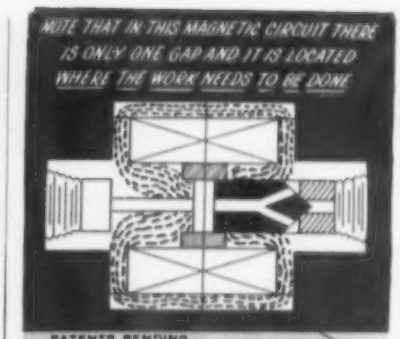
Swept wing requires greater strength in bending than it does in torsion to insure against pitch-up instability.

Swept wings can also cause pitch-up in another way. At high speeds, flow at the wing tips separates at low lift coefficients when the wing is not bending a great deal. This separation causes loss of lift at the tip and the center of lift again moves inboard and forward to pitch the aircraft up.

Spanwise flow on the swept wing thickens the boundary layer towards the tips and it is the reason flow separates first in that region. This problem has been solved by using thin tip sections, leading edge extensions, blunt trailing edges, etc. However, it will always be a major consideration for long span swept wings on which the spanwise flow has a great distance in which to build the boundary layer at the tip.

Roll Problems

Lateral stability of a swept wing aircraft is also tricky for the same reasons that cause pitch-up trouble. Any yawing motion will cause greater asymmetrical loading than on a straight wing because of the swept wing aeroelastic qualities. The difference between the lateral moment arms of the wing lift forces will then be larger than on a straight wing and greater rolling moments result. The thick boundary layer



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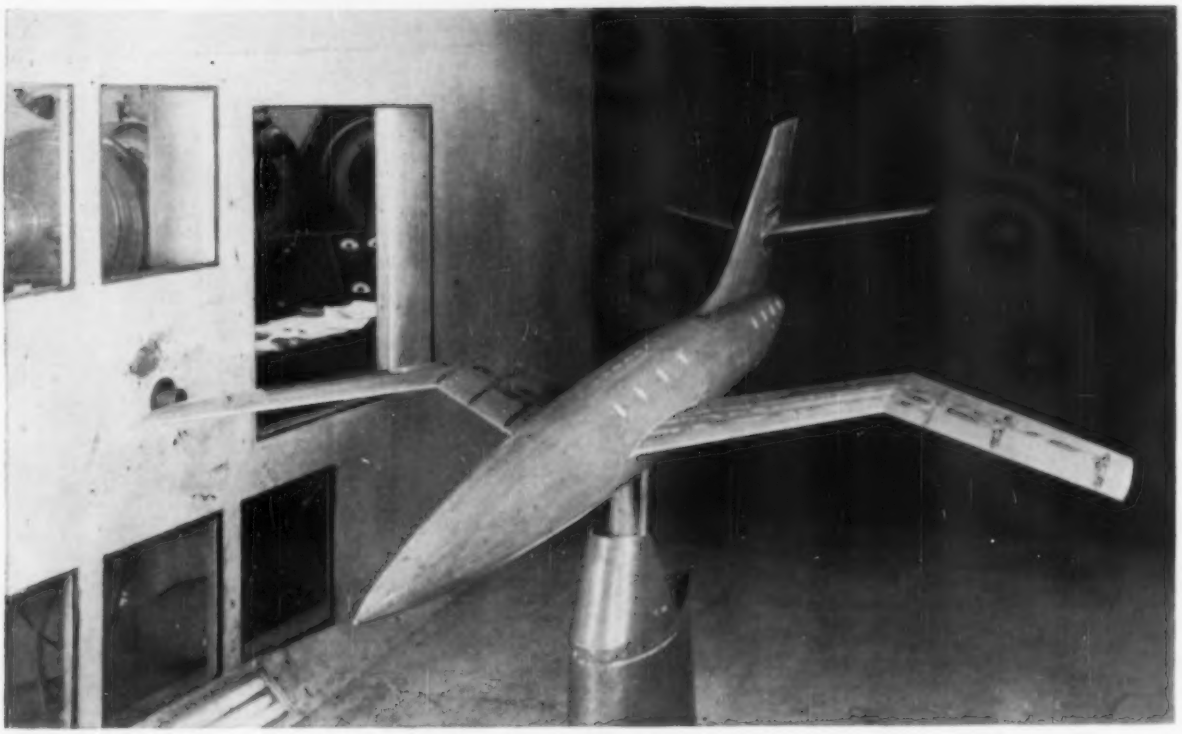

at the tips also affects wing tip ailerons adversely.

Theoretically, and with considerable experimental verification, these advantages are attributed to M and W wings by the NACA:

- **Pitch-up** and lateral stability problems of swept wings are greatly improved, if not eliminated, by proper M and W wing design.
- **M and W wings** generally have more drag than a conventional swept wing at subsonic and transonic speeds but at low supersonic Mach numbers the swept wing advantage disappears.
- **M and W wings** are lighter than a swept wing of equal aspect ratio and bending strength. For a given weight of wing structure, they may be built with a greater aspect ratio and therefore better range characteristic.

Incidence Unaffected

Most important feature of M and W wings is that wing incidence is not affected by bending or torsional loads, eliminating one of the two causes of pitch-up.

The mechanics of how M and W wings achieve this can be seen in the diagram of the M wing. The inner panel acts as a simple swept forward wing which experiences an increase in wing incidence due to its lift load. This increase in incidence due to bending is obvious if wind direction is reversed on the sweptback model on page 50. The lift on the inner panel also acts to increase tip incidence because of its tor-

LOW-SPEED model (above) and high-speed model (below) are typical of those used by the NACA in M and W wing investigations. Test programs have considered various locations of sweep discontinuity and horizontal tail positions.

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sional action around the inner panel's elastic axis. Therefore as wing incidence increases lift increases and vice versa. This tendency of a swept forward wing to self-energize wing divergence is the primary cause of its abandonment as a useful wing type.

On the M wing, this nose-up tendency of the swept forward panel is counteracted by the lift load on the sweptback section which gives a nose-down moment around the inner panel's elastic axis. The outer panel then acts like a separate sweptback wing. Its loss of tip incidence due to its own bending will be low because of its short span. Then, too, it will be possible to counteract any loss of incidence on the tip of the outer panel by allowing the whole outer section to rotate around the elastic axis of the inner panel.

Value to Designer

This interrelationship between the two panels and their loads and structural properties gives the designer a much larger number of controllable variables than he has on a pure swept wing. The NACA feels that the M and W planform will allow enough control over wing twisting and bending characteristics that wing incidence will not change substantially through an aircraft's whole range of flight speeds and attitudes.

Boundary layer growth, the other cause of pitch-up and lateral instability, is also reduced on M and W wings. The length of the swept sections is much shorter than on a simple swept wing of equal span and the boundary layer has less run in which to thicken. This lessens the danger of separation.

In every experimental investigation the M and W wings were markedly superior to the swept wing in lateral and longitudinal stability. The M wing proved generally better stability-wise than the W at all speeds (Mach number of 1.4 was highest tested) and at all lift coefficients.

Concern over very high drag disturbances originating at the juncture of the inner and outer wing panels where the sweep reverses did not really materialize.

At subsonic and transonic Mach numbers M and W wings had more drag than a similar swept wing, but they have much less drag than a straight wing of equal thickness. This shows they retain much of the benefit of sweep. In most cases this amounts to about 80% of the drag savings possible with a pure swept wing.

At low supersonic speeds M wings are roughly comparable to similar swept wings in zero-lift drag, while W wings are not as efficient. The W wing also has greater drag at high lift coefficients in the transonic and low supersonic speed range than the M wing and swept

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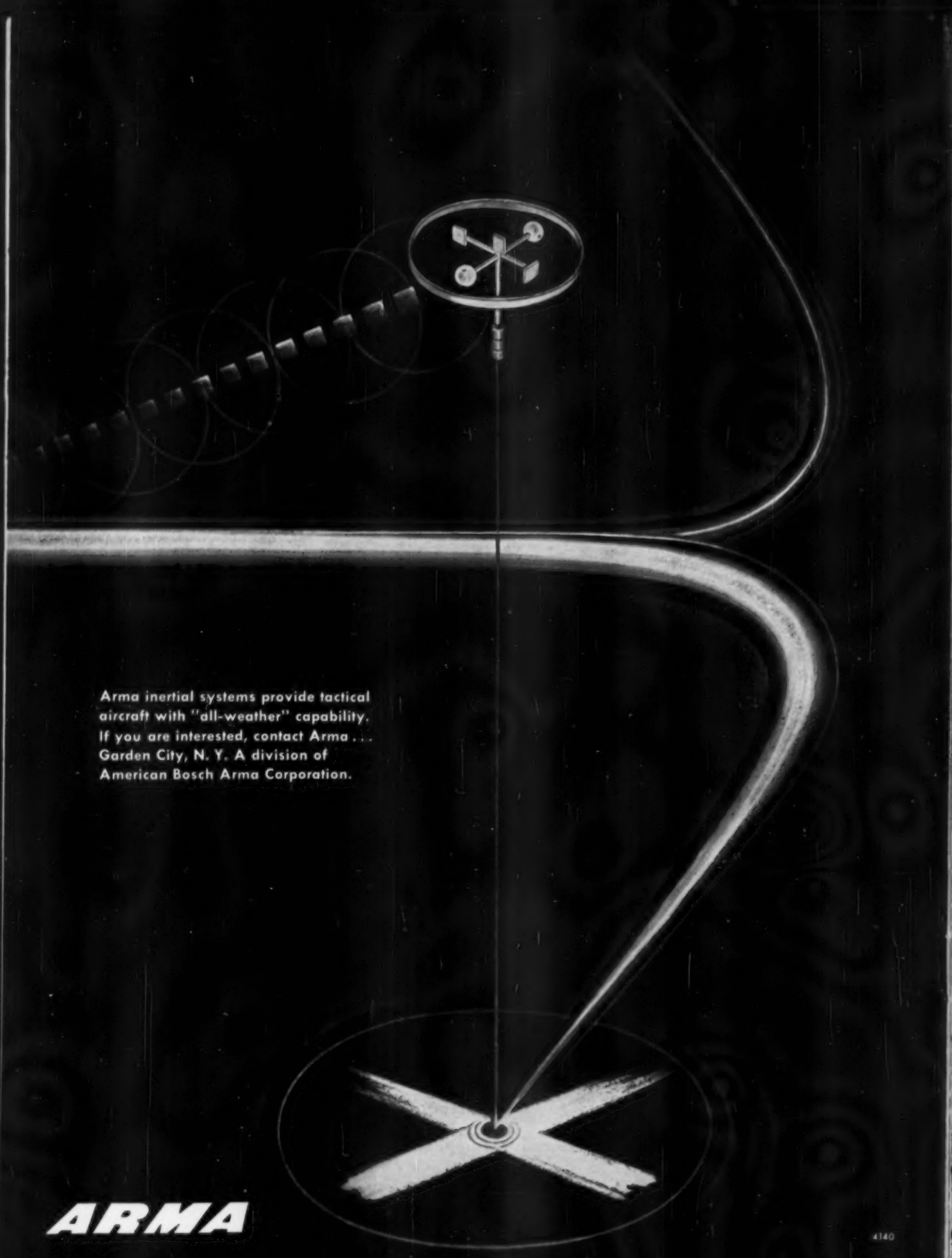

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wing. Swept and M wings are nearly equal in this respect.

The juncture where sweep changes may actually prove to be a drag benefit for M and W wings. Placing engine nacelles or other bodies at the juncture gives more depth for structure in this highly stressed region and if properly shaped may improve the normally poor flow conditions in such a region. Engine nacelles at the junctures would also facilitate the incorporation of boundary layer control systems over the whole wing span.

The opportunity to spread the aircraft volume out by placing large bodies at the wing junctures may aid in area-rule type drag reduction system. Studies of this type are being conducted by the NACA.

Other Composite Wings

Several other types of composite wings have been proposed that would alleviate the aeroelastic and high-speed tip stall problem of the swept wing. One is the crescent wing (also conceived in Germany) in which sweep back angle is decreased towards the tip. This places the outboard sections well ahead of the elastic axis of the wing. The tip load then tends to increase wing incidence and counteract the loss of incidence due to the bending of the highly swept portion. Tendency to tip stall from boundary layer build-up is reduced because of the smaller angle sweep at the tips. Major drawback of this type is the very thin section needed at the tip to make up for loss of sweep.

The aero-isoclinic wing is another answer to the problems of swept wings. This wing, pioneered by G. T. R. Hill in England, is intended to maintain a constant incidence under all design loading conditions. The main wing structure is placed well back in the wing so that the elastic axis is near the trailing edge. The airload then tends to apply a greater torque to the wing to relieve the loss of incidence due to bending.

This type of wing requires great bending strength in relation to its torsional strength which is often difficult to achieve. Under these structural conditions conventional ailerons are not as attractive as rotating wing tip controls.

M and W Disadvantages

The large number of structural variables which allow control of the M and W wings aeroelastic qualities also have the disadvantage of greatly complicating the task of wing design. Precise estimation of the airloads on the wing under all flight conditions is also complicated by the compound sweep. Knowledge of these loads is most critical on the M and W wing if each panel is to react properly and the complete wing

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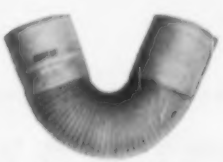

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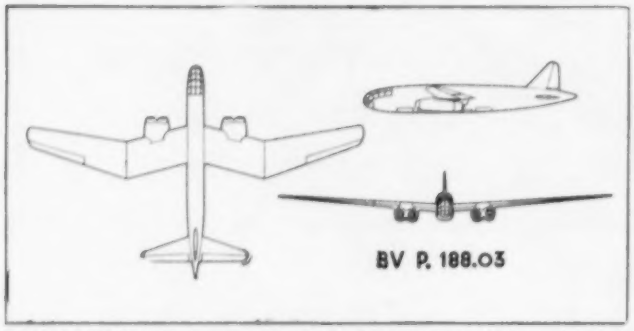

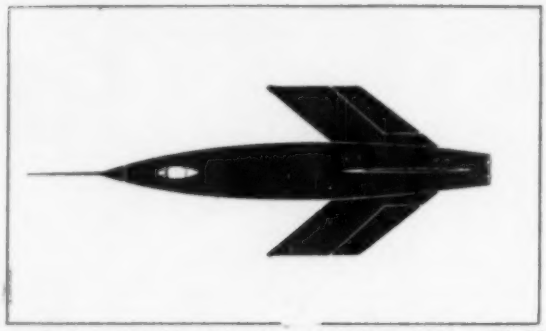

TWO DESIGNS which were never built are indicative of the variety of wing planforms considered in the past. Blohm & Voss World War II proposal (left) had W wing. One configuration studied by Convair (right) for the XB-53 contract had sweptforward wing.

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is to maintain a nearly constant angle of incidence.

Another critical M and W wing consideration is the possibility of wing divergence introduced by the sweptforward section. The tendency of the sweptforward panel to increase its angle of attack as lift increases makes flutter and divergence occur at rather low speeds and requires stiffer wings. Therefore the sweptforward section of M and W wings will usually be of shorter span than the sweptback portion.

This quality of wings with compound sweep also makes them more sensitive to the ratio of torsional to bending strength than other planforms. More expensive aeroelastic development work would then be required before the optimum wing could be achieved for a given aircraft.

German Work

Several agencies and companies in Germany studied sweptforward and sweptback wings before the end of World War II. This activity included flight tests as well as wind tunnel and theoretical work. Enough was accomplished to illuminate the subsonic and transonic benefits and problems of both negative and positive sweep. At least one authority, J. Hubert of Messerschmitt (Augsburg), suggested M and W wings as an answer to the disadvantages of swept wings. However, NACA records of German work indicate that tests on these wings never passed the low speed stage.

The exact reason for suspending the work is not clear. Concern over the possibility of high drag at the wing junctures could have contributed to the termination. However, German scientists at that time had many pressing projects and were also hampered by on-again, off-again financial backing of their work by the Nazi government. This sporadic administrative support and lack of a coordinated continuing research and development policy forced the abandonment of many promising ideas.

NACA work on M and W wings

has been continuous since early 1949 following Rhode's memorandum on their structural possibilities. Considerable test data and theoretical information has been available for 5 or 6 years, but there are no known M and W wing projects in this country. This is puzzling in view of NACA enthusiasm over these planforms. However, the NACA points out that its function is simply to provide basic information for aircraft designers. Its engineers spend little time on the overall problem of aircraft design and are not experts at balancing the myriad conflicting requirements to produce an optimum airplane.

Canada's Avro CF-100 Ordered by Belgium

Belgium has ordered about 60 Avro CF-100 twin-jet all-weather fighters under the mutual aid program from Avro Aircraft Ltd., Toronto, Ontario. Cost of the aircraft totals $43 million, of which Canada is paying 25% and the United States 75%.

Deliveries of the Orenda powered fighters are to start this year and be completed by the end of next year. Belgium earlier had complained U.S. would not release radar used in the airplane (AW Feb. 25, p. 324).

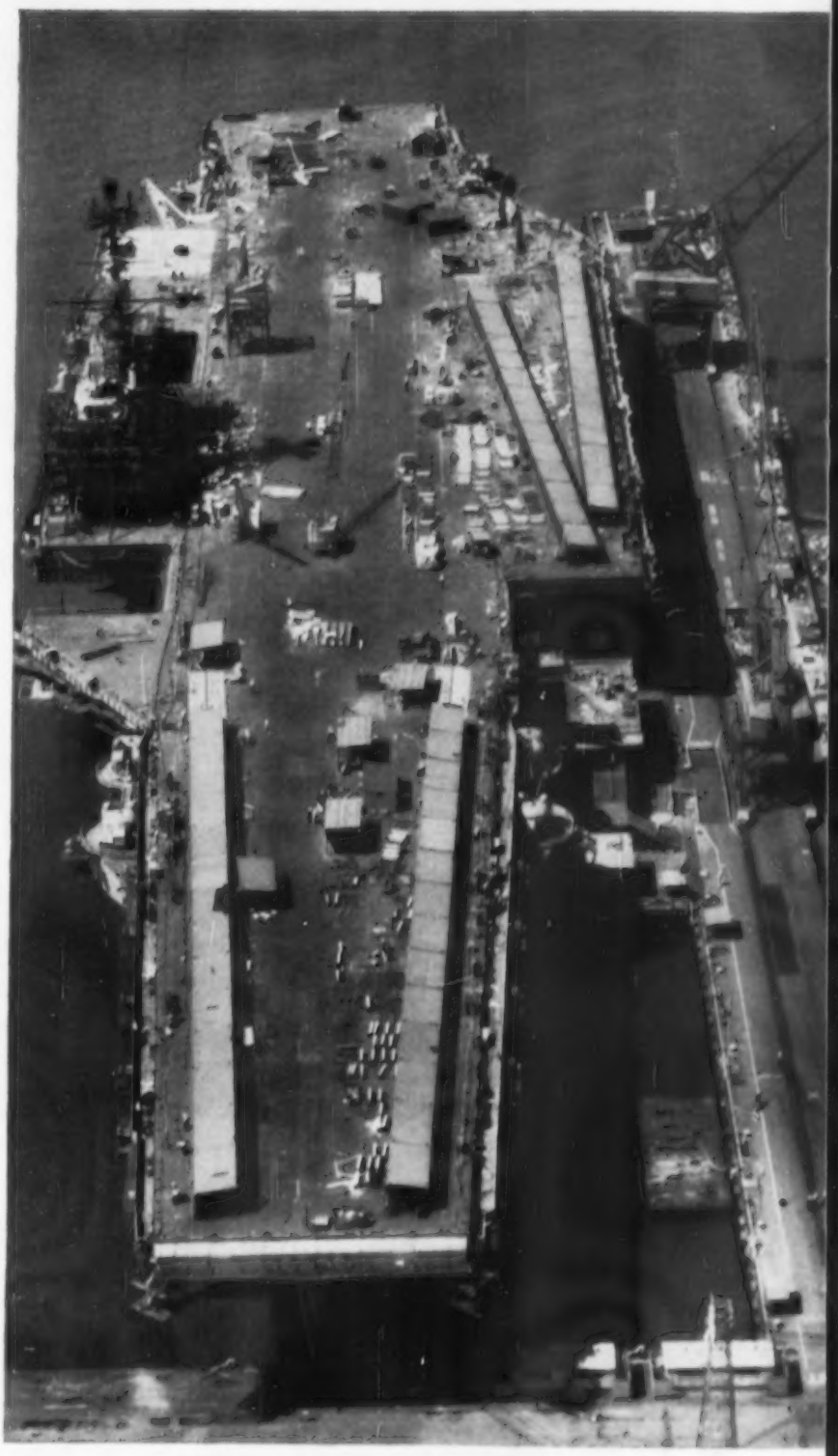
This is the first time that a Canadian-designed combat aircraft has been chosen by another country.

Boeing Engineers Win 'Unleveling' Pay Rise

Engineering employes of the Boeing Airplane Co., Seattle, accepted a new one-year labor contract which calls for a 4% salary increase, with an additional "unleveling increase" of up to 2% for those who earn more than $572 per month.

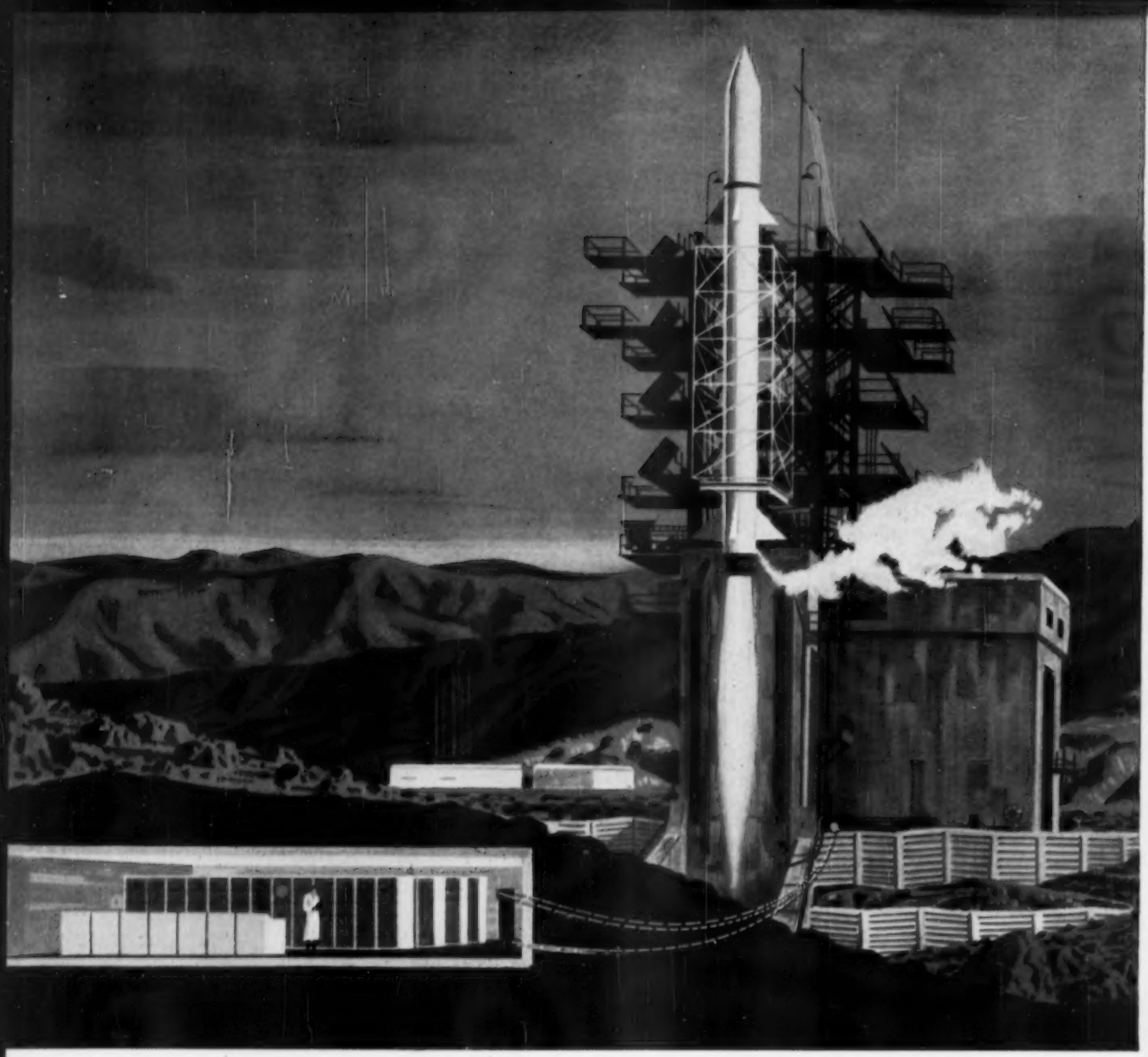
The 4% increase, retroactive to May 11, was determined by the increase in salaries presently offered new engineers over the salaries offered new engineers last year, Dan Hendricks, Jr., president of the Seattle Professional Engineering Employes Assn., said. The "unleveling increase," which is determined on a sliding scale from zero at $572 to 2% at $700 or more, is intended to compensate for previous years, when the salaries of beginning engineers increased faster than those with more seniority.

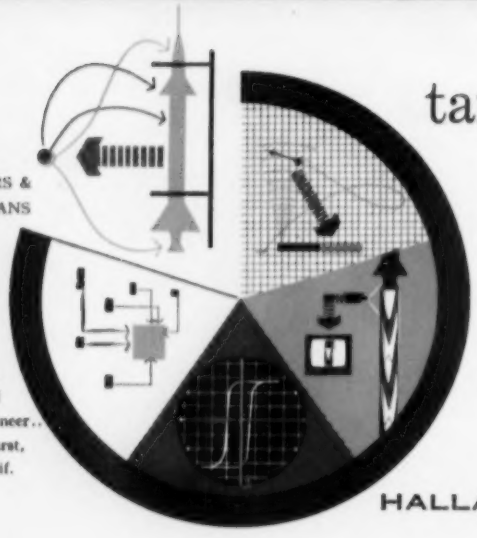
The contract covers 5,700 employes at Seattle and 1,300 at Wichita, Kans. Sixty percent of engineering employes will benefit from the "unleveling increase," which draws its description from the association's claim that the higher salaries paid new engineers had a tendency to level off all salaries, without proper regard for the experience of the older engineers.



Ranger Is Fitted Out

Supercarrier Ranger, third of the U. S. Navy's 60,000 ton Forrestal class, is being fitted out at the Naval Ship Yard, Norfolk, Va. First two, Forrestal and Saratoga, are in fleet service. Shelters on bow approximate positions of catapults. Extension for angled deck is on opposite side of island.





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7-57

O-Ring Valve Used In Manned Rockets

Teterboro, N. J.—High pressure valve using an O-ring seat has demonstrated such reliability that it is being incorporated in the motors for several manned rocketplanes. North American X-15 is the only such project revealed.

Principle of operation makes the valve relatively insensitive to manufacturing tolerances and reduces its size and weight. These features plus the very low sealing and operating force required (about 6 lb. on a 3,000 psi. line) have brought close attention from several powerplant and accessory manufacturers.

Normally, high pressure valves must have tapered seats lined with a hard material. Malfunctioning is caused by small scratches and slight tolerance errors and proper installation requires considerable skill. The new valve, called the "captive seal valve," has succeeded in maintaining a constant force on the O-ring seat during the opening process and preventing it from blowing out under high pressure. This blowing out problem has, until now, prevented the use of the inexpensive O-ring as a high-pressure seat.

The new valve was designed by the Bergen Research Engineering Corp. with the invention ascribed to Peter H. Palen of that organization. The Bergen group is a small company, formerly a subsidiary of Aerojet-General, which confines its operation to original design and development work. Promising devices are licensed for production.

Bergen has formed a subsidiary, The Bergen Captive Seal Valve Corp., to develop further the new principle and has assigned production rights to Bridgeport Thermostat Division of Robertshaw-Fulton Controls Co. Other main Bergen product is a line of very small, shock resistant cap switches. Company research projects range from laying submarine cable to aircraft proposals.

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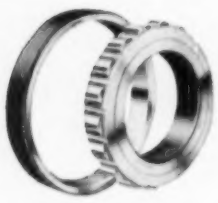

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HYATT HY-ROLL BEARINGS FOR AIRCRAFT INDUSTRY

DAN Rockets Will Correlate Solar Flare, Radio Fadeout Data for IGY

By Russell Hawkes

San Nicolas Island, Calif.—First U.S. rocket firing of the International Geophysical Year was made from this site on the offshore range of the Naval Air Missile Test Center, Point Mugu.

It was the first of a series of 14 DAN rockets—Deacon sustainer with Nike Ajax booster—to be fired this summer by the Naval Research Laboratory in an effort to correlate ultra-violet, X-ray and Gamma emissions of solar flares with radio fade-out due to increased electron density in the ionosphere.

Dr. Herbert Friedman of NRL is in charge of the tests. He is also supervising the solar radiation measurements to be made in Project Vanguard.

Solar Study

Last week's launching was the only one to be scheduled in advance. Future launchings will be made only when it has been determined that a flare is in progress.

The short duration of some flares demands that rocket crews and scientists be ready to fire at any moment. The relatively light firing load at Mugu has enabled range officers to permit the NRL project to fire on one minute notice.

San Nicolas Island is 65 miles down range from Mugu.

The first shot was intended to record normal background signals in the ultra-violet, X-ray and Gamma bands as baselines for comparison with signals recorded during flares.

Communication Link

Observatories at Climax, Colo., Sacramento Peak, N. M., and Mount Wilson, Calif., will observe the sun closely during the tests. Experienced astronomers can tell by the appearance of sun whether a flare is likely. There is a direct teletype connection between San Nicolas and Sacramento Peak. Mount Wilson and Climax have radio links.

Fast communication allows the observatories to notify the San Nicolas group that a flare has begun in time to get rocket aloft for measurements. Signals on six radio frequencies between nine and 17 megacycles are monitored for fade-out indication of flare.

Dr. Friedman estimates that his crew will be able to get a rocket aloft within four minutes after the beginning of a flare.

Firing Sequence

It will take about one minute to determine that a flare is actually beginning and about three minutes to get a range clearance, warm up the instruments, check out the telemetering equipment and firing controls, clear the pad area and fire the rocket up into the ionosphere. Flares may reach their peak intensity in about five minutes.

Friedman says it may be possible to cut the checkout sequence to little over one minute.

The rocketry side of firings is being handled by technicians from Cooper Development Corp., which also holds the systems contract for assembly of the rocket and manufacture of special equipment. Cost of project is $150,000 exclusive of salaries for NRL personnel.

The low figure is made possible largely by Cooper's use of free Nike Ajax boosters and obsolescent Deacons rather than more costly modern high performance systems.

The outdated combination works out

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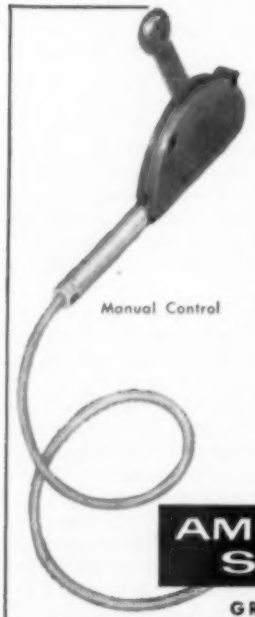

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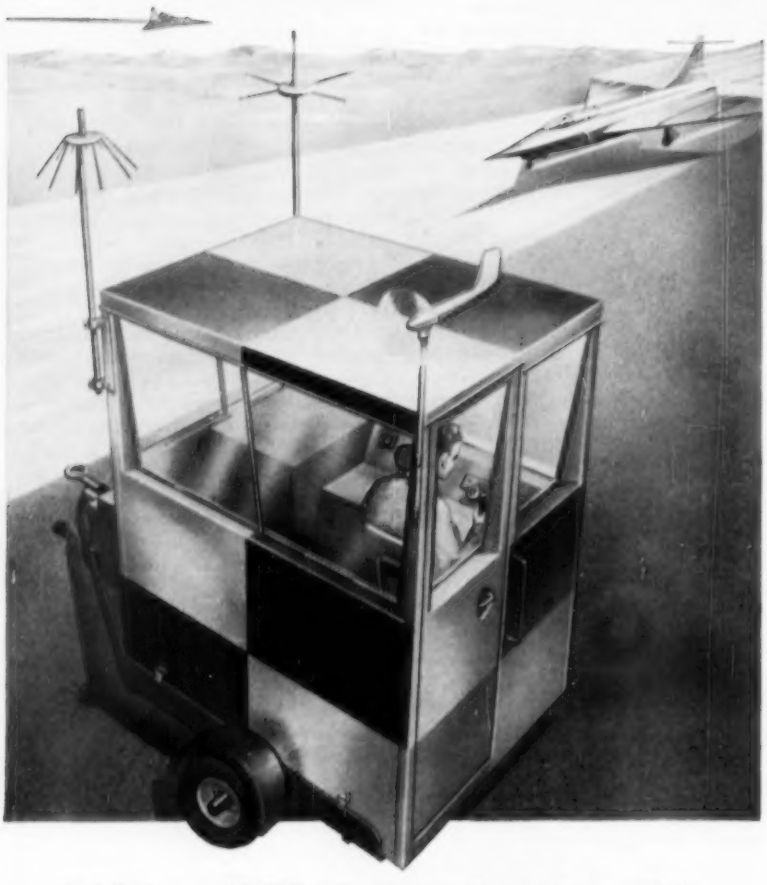

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well for this project because the ionization phenomena of interest to the NRL scientists occur chiefly in the D and E regions of the lower ionosphere.

These regions are in the altitudes between 50 and 70 miles—well within range of the Nike-Deacon which is capable of about 80 miles in the configuration being used. It takes 90 seconds to reach an altitude where useful measurements can be made. Records may be taken for two or three minutes before the rocket falls back into dense, radiation attenuating air.

Flight Duration

Duration of last week's flight was four min., 56 sec. from launch to impact of the Deacon. The summit was between 75 and 80 miles. Dr. Friedman expressed satisfaction with the outcome of the test on the basis of a quick glance at the data. No X-ray signal was recorded.

This establishes the fact that there is none when there is no flare activity on the side of the sun toward the earth. Some doubt of this was created when a Rockoon fired last year recorded X-rays during a flare considered too small to produce radiation reaching the earth.

Instruments in the present project's rockets measure soft X-rays in the wave length range from one to six angstroms. Another Geiger counter is set to detect hard X-rays of .5 to .05 angstroms.

Low Ultra-Violet Level

Quick examination of the record of the baseline test indicates a lower ultraviolet level than expected. The NRL scientists have not yet determined whether this is caused by a low output from the sun or because of aspect of the sun from the rocket. Analysis of the record from a photocell in the rocket will make it possible to determine what the aspect was.

The rocket was designed to slow roll at a rate of about 20 rpm. A certain amount of yaw was anticipated and necessary to bring the sun within the field of the detectors which were mounted looking out of the sides of rocket.

Time between peaks registered by the sun and the horizon on the photo cell record are used to calculate roll and yaw.

Ultra-violet measurements are taken at the Lyman-Alpha Line—1216 angstroms. This wave length has special significance in solar studies as it is the resonance line of hydrogen, the most common substance in the sun. The Lyman-Alpha Line is quite narrow, only about 0.1 angstrom. It is in the frequency range called Vacuum Ultra-Violet since it is completely absorbed in a few inches of air at sea level density.

WHAT'S NEW

Reports Available

The following publications are available from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D. C.:

AEC Research Reports Price List No. 27—Available without charge. Contains over 3,600 AEC reports in the OTS collection, 454 of them acquired since June 30, 1956.

Survey of Low-Alloy Aircraft Steels Heat Treated to High Strength Levels: Part 3-Failure Causes—by G. Sachs, Syracuse University for Wright Air Development Center. $2.00; 80 pp. (PB 121667)

Prevention of Mechanical Vibrations in Electronic Chassis-Design Manual—by W. F. Stokey, C. F. Zorowski, and F. C. Appl, Carnegie Institute of Technology for Rome Air Development Center. $2.50; 96 pp. (PB 121564)

Effects of Specimen Preparation on Fatigue—by F. H. Vitovec and H. F. Binder, University of Minnesota for Wright Air Development Center. $1.50; 53 pp. (PB 121576)

Slip Damping of Press-Fit Joints Under Linearly Varying Pressure—by J. H. Klumpp and L. E. Goodman, University of Minnesota for Wright Air Development Center. $1.25; 47 pp.

Investigation of the Compressive, Bearing, and Shear Creep-Rupture Properties of Aircraft Structural Metals and Joints at Elevated Temperatures—by F. J. Vawter and others, Cornell Aeronautical Laboratory, Inc., for Wright Air Development Center. $2.50; 95 pp. (PB 121656)

Fatigue, Creep, and Rupture Properties of Heat Resistant Materials—by F. H. Vitovec and B. J. Lazan, University of Minnesota for Wright Air Development Center. $5.50; 213 pp. (PB 121580)

Rate of Information Transfer with Seven Symbolic Visual Codes: Motor and Verbal Responses—by E. A. Alluisi and P. F. Muller, Jr., The Ohio State University and The OSU Research Foundation for Wright Air Development Center. $1.00; 31 pp. (PB 121719)

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WIDE ANGLE CAMERAS are mounted in wing-tip pods of Ryan Firebee (left above). Remotely controlled cameras record track of missile as it approaches the drone. Smoke generators are mounted under Firebee wings to provide absolute visual identification (right).

Radar, Smoke, Flares Identify Firebee

INFRARED FLARES attached to Firebee empennage emit heat, enabling heat-seeking weapons to home on the target drone.

Detectability of Ryan KDA Firebee air-launched target drone is increased by radar reflector pods, infrared lamps and flares, and smoke generators to simulate large multi-engined jet bomber. Radar reflectors may be usual corner reflectors or Luneberg lenses composed of concentric layers of radio frequency refractive plastics. Reflectors must be mounted to assist attacks from any direction.

Reflector design is complicated by use of ground, airborne and missile radars operating in different frequency bands. Strong signal may also be produced by putting radar beacon in drone to be triggered by pulse from attacker's radar, but time lag in beacon operation introduces range error unless compensated.

Jet efflux of enemy bomber can be simulated to aid heat-seekers by smaller, hotter infrared source. Lamp has the advantage of burning continuously for long periods but its energy is concentrated in a narrow beam. Flare is less directional but has short duration. Cameras mounted in tip pods with overlapping fields record line of approach of missile. Nearest point can be computed by triangulation or image comparison.

RADAR REFLECTOR mounted in tail of Firebee (left) increases range at which the drone can be "seen" by radar receiving equipment. Infrared lights on wing-tips of Firebee (right) approximate jet tailpipe temperatures, attract heat-seeking missiles.

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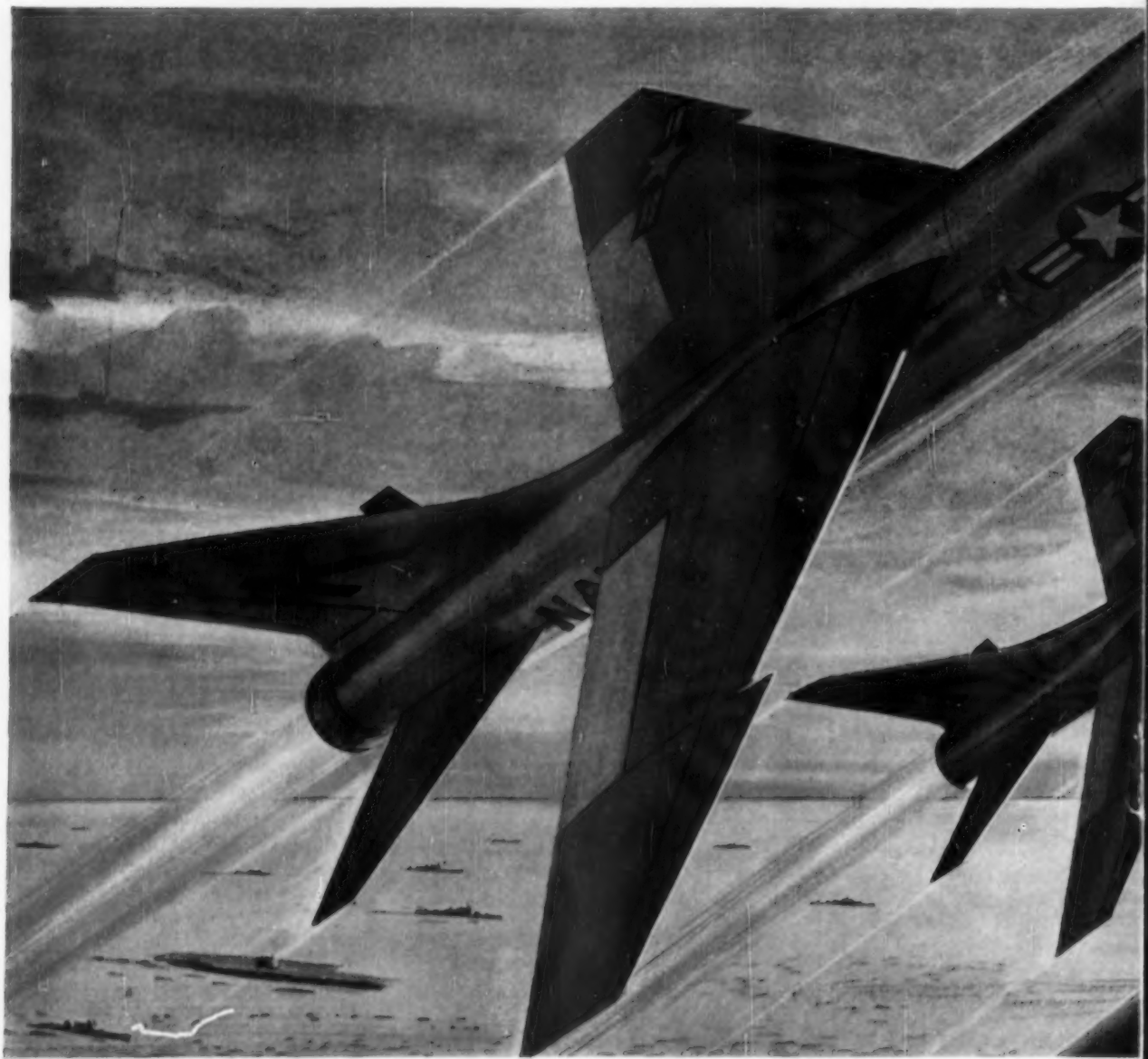

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Navy fighter squadron---

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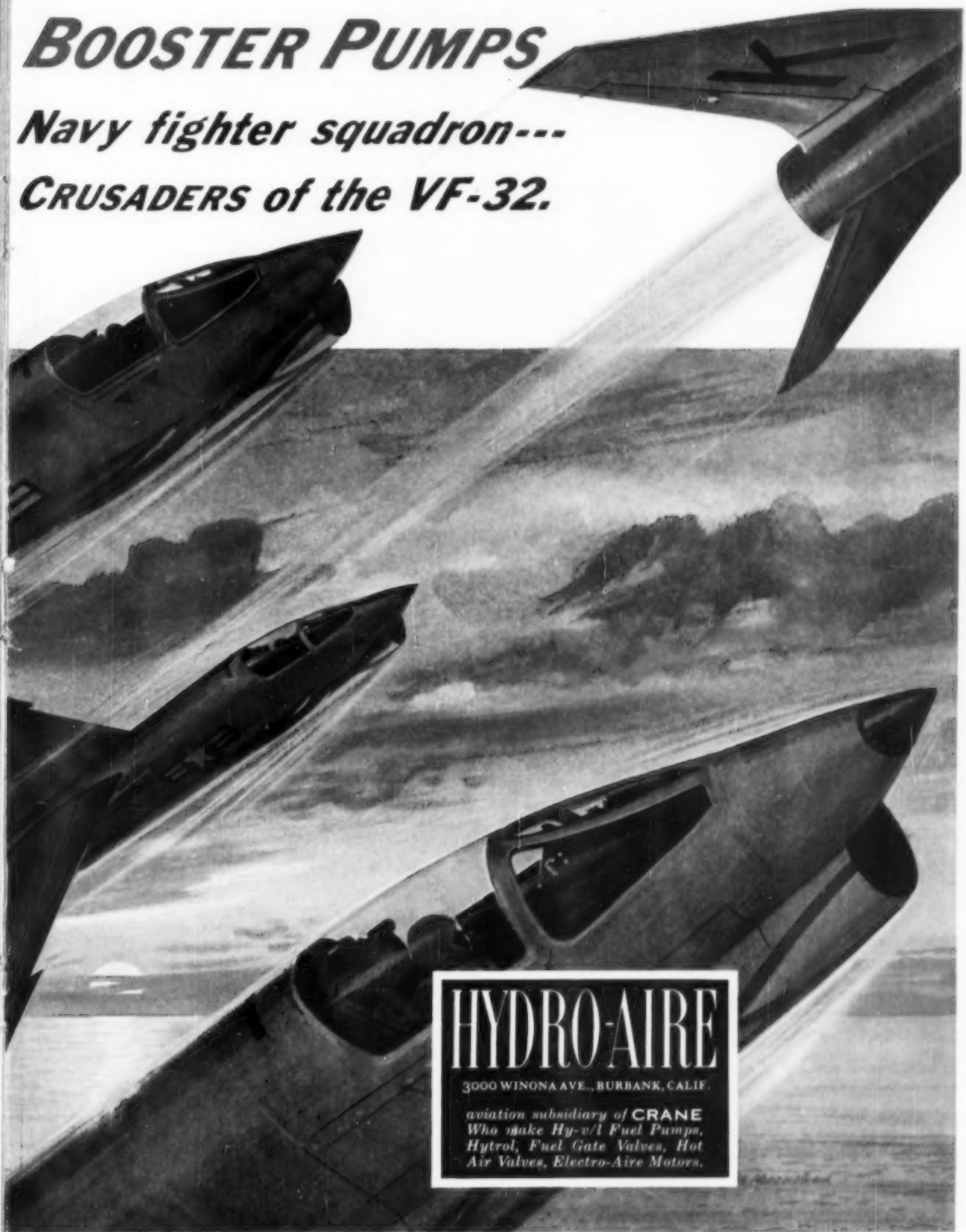

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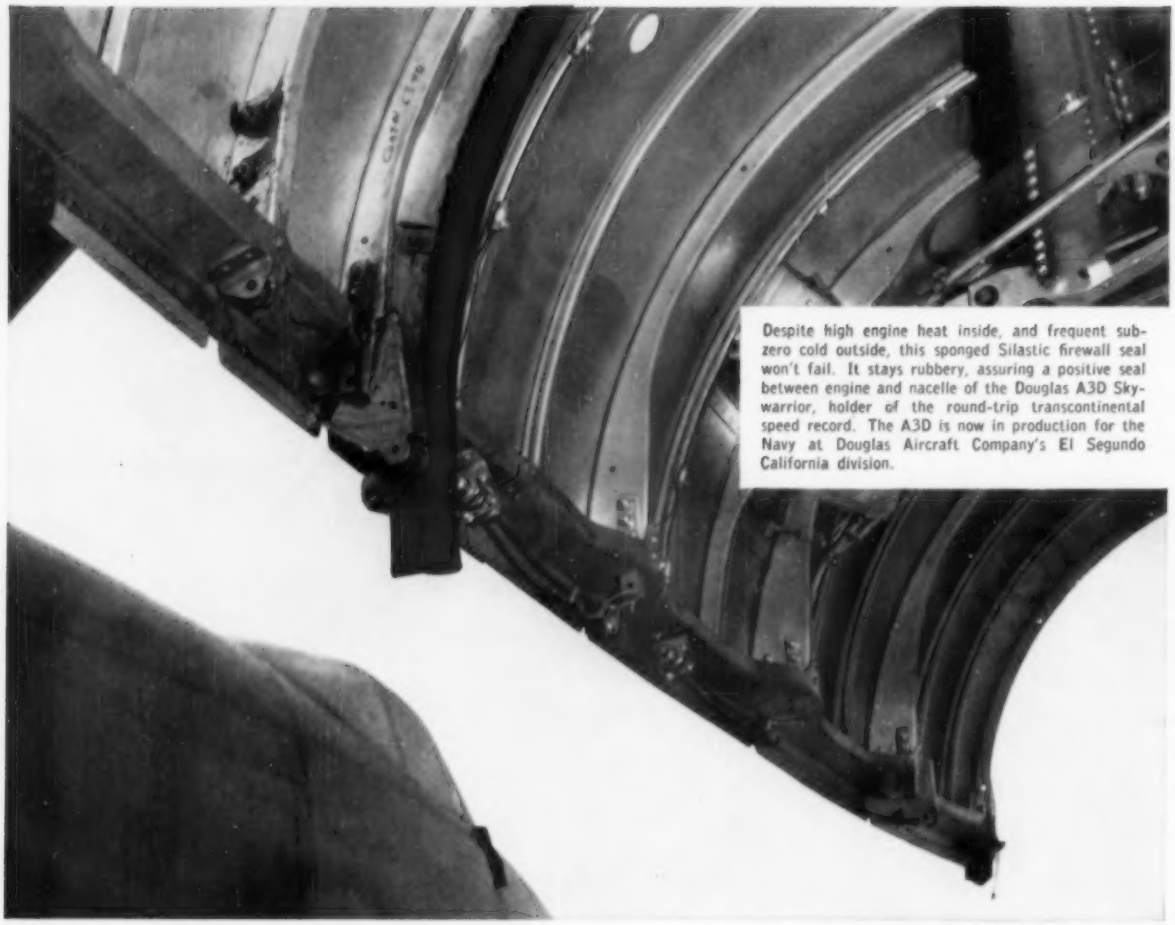

Despite high engine heat inside, and frequent sub-zero cold outside, this sponged Silastic firewall seal won't fail. It stays rubbery, assuring a positive seal between engine and nacelle of the Douglas A3D Skywarrior, holder of the round-trip transcontinental speed record. The A3D is now in production for the Navy at Douglas Aircraft Company's El Segundo California division.

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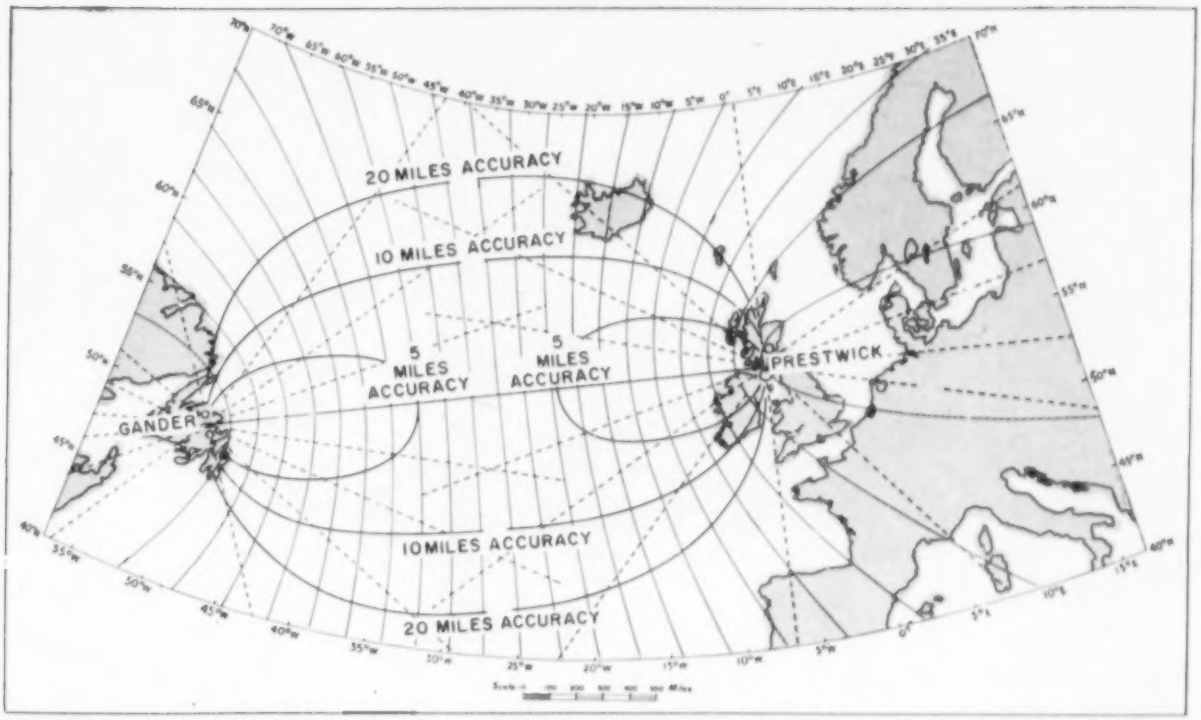


DECTRA PLAN for the North Atlantic. Approximately every 100 lanes of tracking patterns are shown and every 100 lanes of ranging pattern. Accuracy contours refer to range errors only; track errors will be less.

Dectra Begins Vital Atlantic Evaluation

By James A. Fusca

Evaluation tests on Dectra, a highly accurate British long-range hyperbolic navigation system, have begun over the heavily traveled North Atlantic air route between Gander, Newfoundland, and Prestwick, Scotland.

Dectra is expected to reduce present aircraft separation standards from 120 miles laterally and 30 minutes longitudinally to 30 miles and 10 minutes, respectvicly, according to Decca Navigator Co. which developed the system under British government sponsorship.

Pacific Division of Bendix Aviation, which already holds U. S. license rights to the British Decca system, is expected to gain formal U. S. rights to Dectra this week.

British Bid

Successful results in the current tests will greatly strengthen the British bid for adoption of Dectra by the International Civil Aviation Organization as the standard long-range navigation system. The official U. S. contender, Navarho, is undergoing preliminary tests by the Rome Air Development Center, but reportedly is lagging behind earlier schedules.

If the Dectra system fulfills its proponents' expectations, backers of other long-range systems, such as Navarho, Loran-C (Cytac) and Radio Web, may be confronted with a fait accompli by a navigation system already in use across the North Atlantic.

The six-month Dectra evaluation program is under the joint support of the British and Canadian governments and will include participation by several international airlines. British Overseas Airways, Trans Canada, Pan American, Scandinavian Airlines Systems, KLM Royal Dutch Airlines and Swissair reportedly have indicated a desire to participate.

A British Ministry of Supply four-jet V-class Valiant bomber has been equipped for Dectra use and presently is making test flights under the guidance of the Newfoundland chain. Data will also be collected by passenger and weather ships.

Designed primarily to meet the requirements of fast jet traffic over routes up to 2,000 miles in length, the low-frequency (70-72 kc.) hyperbolic Dectra system is expected to ease greatly the growing air traffic congestion over the North Atlantic, according to representatives of the British Decca Navigator Co.

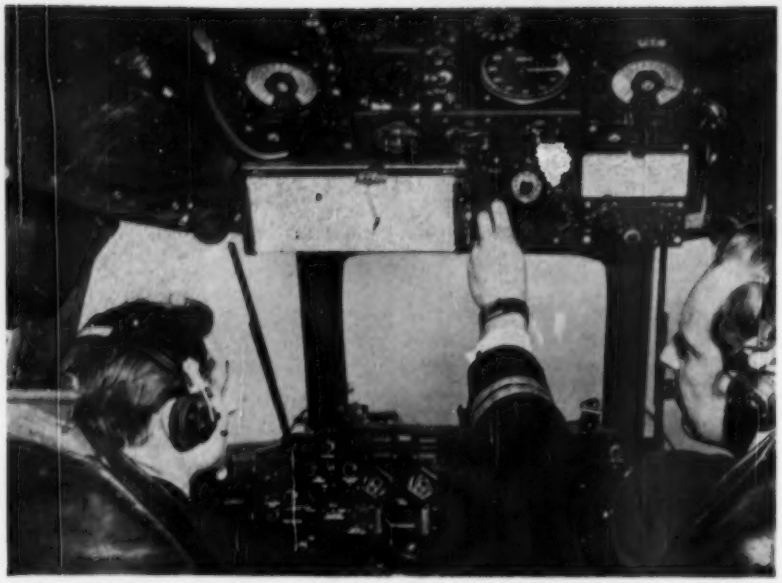
Dectra is expected to provide maximum errors of less than five miles in track and 10 miles in range, with range error being cumulative along the route and track error decreasing in both directions from the route midpoint.

Answers to two questions raised by navigation experts in this country and abroad will be sought during the trials: first, can Dectra stay within the claimed

New York to London Dectra Coverage

Signal strength and reliability of transmissions from the Newfoundland Dectra chain have exceeded expectations, opening the possibility that only the installation of a single transmitter, to provide range information, will be required in Great Britain.

If so, installation of a single range-only Dectra transmitter in the New York or Washington area would provide full Dectra coverage from major eastern U. S. ports to Newfoundland, using the "back cover" from the Newfoundland stations, and hence to Great Britain, using the "forward cover."



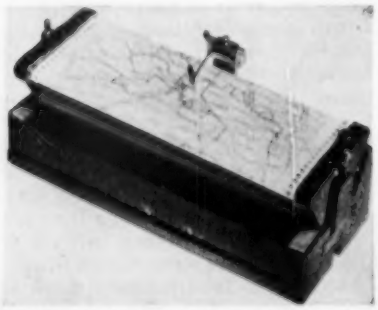
DECCA FLIGHT LOG installed in cockpit of BEA Viscount. Decca Mark 10 receiver is capable of dual Decca and Dectra operation with addition of Dectra range unit.

maximum cumulative range error and, second, will system performance degenerate in areas of strong ground and sky wave mixing.

Dectra's developers are optimistic about the anticipated results. Addressing a British Institute of Navigation meeting last Fall, G. Hawker of the Decca Navigator Company stated that, although much remains to be learned about Dectra's composite-wave performance, company engineers do not expect to lose more than two or three lanes (basic lane widths being 1¼ miles) in the course of a flight across the Atlantic.

Point to Point System

Dectra chains comprised of a master and slave station pair normally will be placed astride each end of a proposed route. The two chains are aligned so that the hyperbolic position lines (lines of constant phase difference) generated by the phase-locked transmissions of each master and slave pair form a family of tracks between the chains, varying in separation from two miles near the approach areas to 30 miles at midroute. Range along the tracks is established by the phase relationship between the two master station transmissions.



DECCA FLIGHT LOG. Pen is driven by worm gear, chart by sprocket wheels.

Airborne Installation

The airborne Dectra installation weighs approximately 140 lb., including the Decca Flight Log, a servo-driven chart storage and cockpit display device with a 10-inch by 4-inch presentation. A continuous 16-foot Flight Log chart has been prepared for flights in each direction between Gander and Prestwick so that in-flight chart changes are unnecessary.

Of the 31 Dectra tracks that fall within the 10-mile accuracy contours, the 15 tracks lying south of the great circle route normally will be flown by eastbound aircraft and the 15 northern tracks by westbound aircraft.

In addition to the tracks to be flown, the charts include the Dectra lattices, mileage and bearings and coastlines printed in black. A latitude and longitude grid is overprinted in red. On the back of the charts, invisible until the backlighting has been turned on, is an immediate diversion pattern giving information on track, bearing and distance to the nearest diversion airfield. The pilot would use this information to establish his diversion course before changing to the small-scale diversion chart at one end of the route chart.

Approach charts, included at each end of the route charts, are standard Decca area coverage charts. The Decca lattices are printed in color with a

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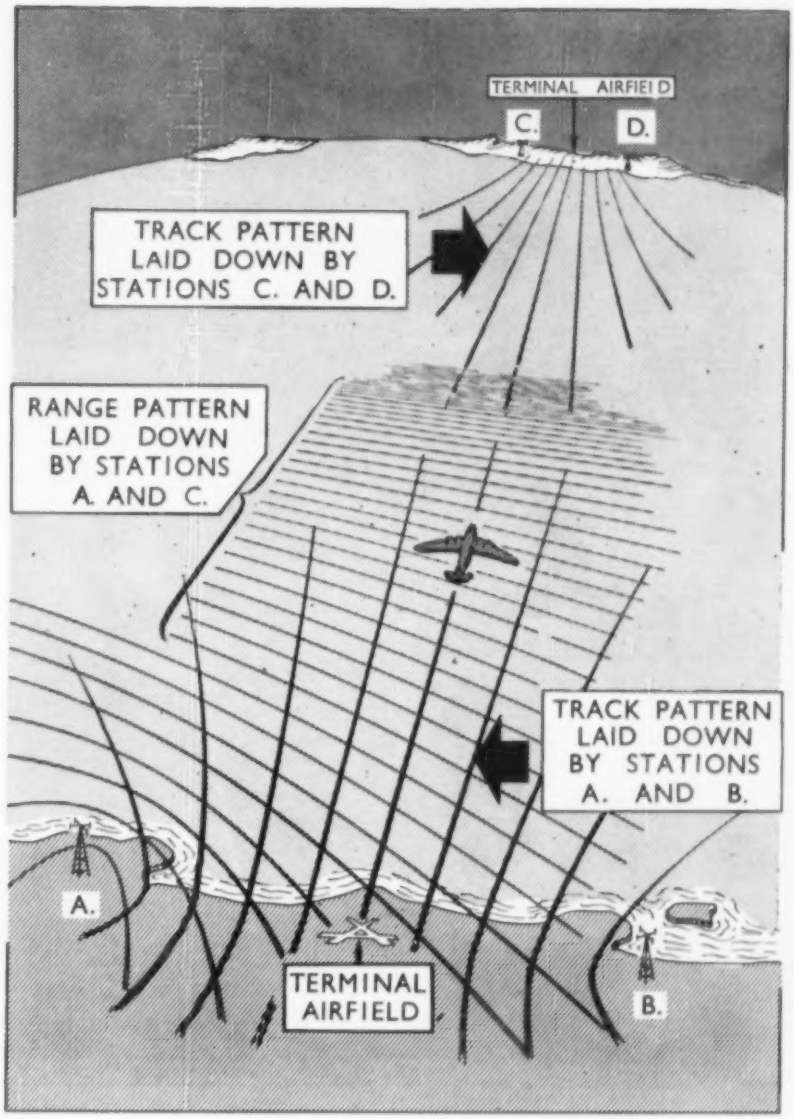

DECTRA RANGE and track patterns showing in diagramatic form layout of Gander, Newfoundland, and Prestwick, Scotland, Dectra chains.

black overprint of approach and topographical information.

Dectra is an outgrowth of the medium-range Decca navigation system in use throughout much of Europe. The two systems are highly compatible and their installations normally will be integrated. The master and slave pair making up the Dectra installation in Newfoundland, for example, also serves as two of the four stations of the Newfoundland Decca chain known as Moose East.

Dectra airborne equipment demonstrates similar compatibility. The present Decca Mark 10 receiver with the addition of a Dectra range unit is capable of dual operation, permitting a pilot to choose Dectra for long-range, point to point navigation and Decca for high-accuracy area coverage near the terminals.

The close interrelation of Dectra and Decca stems from Decca's methods of pattern generation and lane identification. Decca is based upon the phase comparison of continuous wave transmissions from a master and three slave stations. Because the slave station signals are phase-locked with those of the master, phase patterns or "lanes" are produced by each master and slave combination to form an overlapping omnidirectional navigation grid.

Decca Fundamentals

The four Decca transmission frequencies are harmonically related to a fundamental frequency F (approximately 14 kc). The master station transmits at

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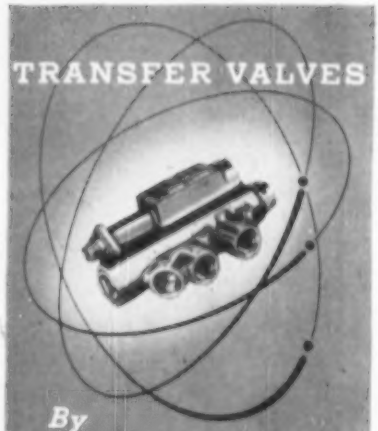

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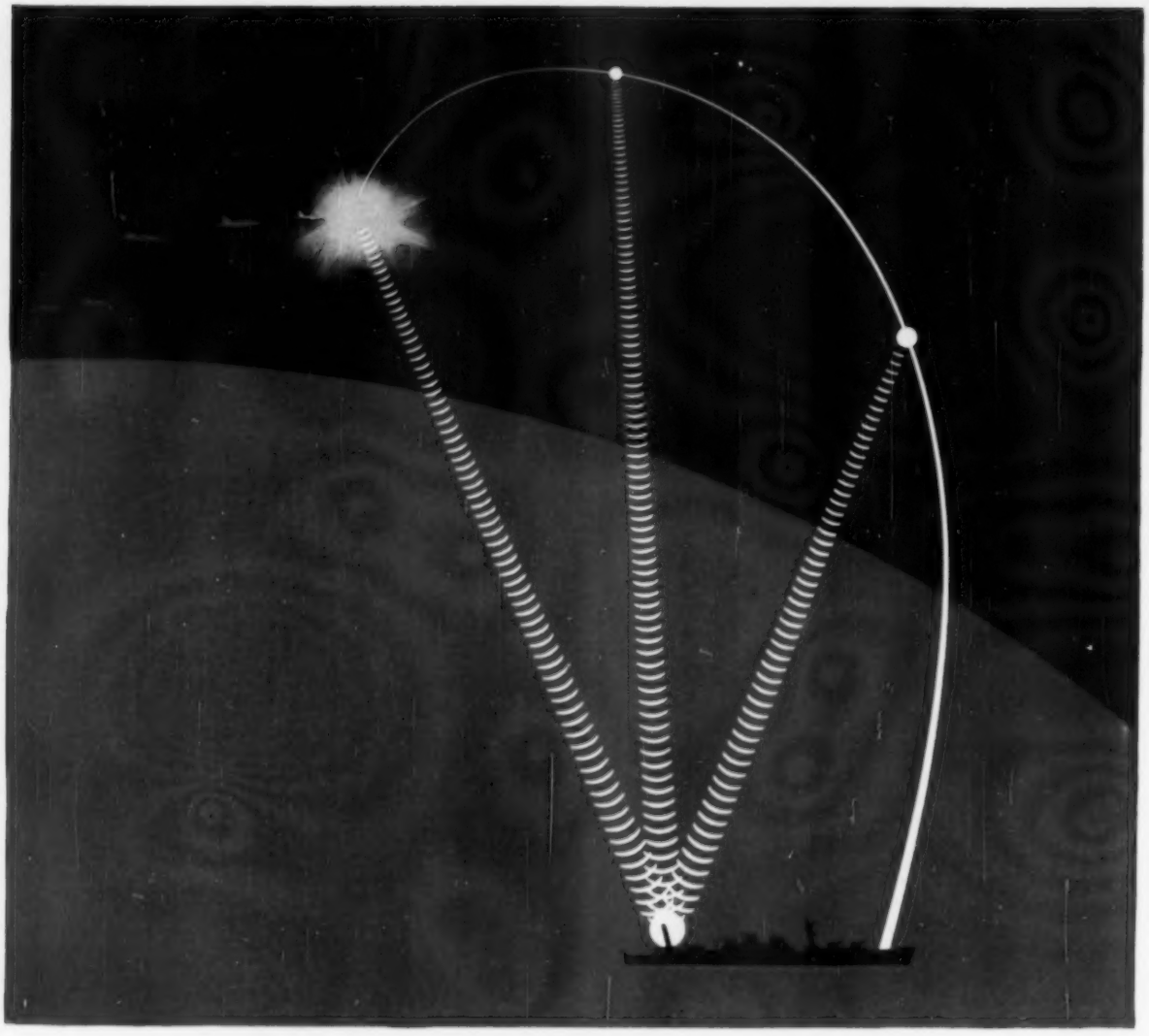

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6F and the red, green, and purple slaves (identified by the colors in which their grid patterns are printed on Decca charts) at 8F, 9F, and 5F, respectively.

For example, in the case of the English Decca chain F is approximately equal to 14.17 kc. The master station transmits on 85 kc (6F), the red slave on 113.3 kc (8F), the green slave on 127.5 kc (9F), and the purple slave on 70.8 kc (5F).

Interruption Interval

Decca transmissions are interrupted three times per minute for the transmission of lane identification signals. During each of the three interruptions the master station transmits for 0.5 seconds on the master frequency (6F) and the purple slave frequency (5F). During each break a different slave transmits simultaneous signals at 8F and 9F. These signals yield 1F beatnotes of high phase stability which the Decca receiver compares to derive approximate position.

Dectra is a continuous-wave, phase-comparison system employing frequency and time multiplexing. It employs a master and slave station pair set up on a base line that lies normal to, and is bisected by, a great circle drawn through the terminal points of the route, with a master-slave pair at each end.

Dectra can operate anywhere in the low-frequency band. However, by operating in the 70-72 kc. band, it is possible to use two of the same stations employed for the Decca system. These are the Decca master, transmitting at 6F and the Decca purple slave operating at 5F.

Dectra Principles

To illustrate the principles of the system, consider the master station of one Dectra chain to be transmitting at frequency F_1 except for three short breaks per minute when the master station shuts down and the slave transmits, also at F_1, a signal phase-locked to that of the master station. The second Dectra chain, at the other end of the route, will be transmitting at frequency F_2. The frequencies F_1 and F_2 are chosen to be integral multiples of a common subharmonic f so that $F_2 = nf$ and $F_1 = (n+1)f$. (A relatively stable phase relationship of the f subharmonic is achieved by using the F_2 master signal received at the other Dectra master to control the F_1 frequency.)

Position of an aircraft relative to the family of tracks generated by each Dectra chain is determined by phase comparison of the master and slave transmissions from F_1 or F_2. The track indication is constant along a hyperbolic line of position which has the two stations in use as foci.

Range, or distance along the track,

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.
BY MARVIN MILES

You read about NATO and USAFE, of the Third Air Force, the Twelfth Air Force and the Seventeenth, but somehow—unless you're a military man or an adept student of the military—these forces are vague in their distance, names with too few specifics, too little reality.

But a tour of USAFE/NATO bases in Europe and the Middle East brings into sharp and impressive focus the vital importance of these bastions in (1) preventing the detonation of World War III, and (2) assuring the annihilation of Russia if such a holocaust should ever be triggered.

I would say it is impossible that anyone who hears a frank, clear-cut briefing in Paris by General Lauris Norstad, Supreme Allied Commander Europe, can fail to agree that the safety of the free world depends to a great degree on NATO'S sword and its shield backed by the unswerving determination of 15 treaty nations.

You have only to listen to this brilliant and dedicated officer detail how the Soviet is being more and more contained by the interlocked shield of NATO divisions and squadrons forged along the Iron Curtain borders—how the retaliatory sword of strategic air power can strike from 360 degrees with nuclear devastation if the shield is pierced by invasion at any point.

In essence the plan is simple. The combined efforts of 15 free nations keep the shield ready and ever alert, not a massive shield, but just enough ground Naval and tactical air power to prevent a USSR "walk-in," enough to stem the tide until NATO'S aerial sword can be swung.

Russia knows that a penetration anywhere will bring immediate resistance and label her as the aggressor. She knows that retaliation can be swift and sure. Nor could she prevent her own destruction for she cannot hope to silence all the strategic air bases (and the U.S. Sixth Fleet) that encircle her.

Hence General Norstad, an international commander, feels that the danger of a deliberate Russian decision to go to war is relatively small. He fears more a chance, hot-blooded incident followed by the use of large forces and great power.

Nor does he have much faith that such an eruption could be restrained by agreement to standard weapons or small nuclear power. "If anything does start," he told our touring USAF news group recently, "there will be a rapid tendency for it to get bigger and faster."

He described the stalemate as an endurance test with a forfeit terrible to contemplate -- and the NATO integrated deterrent strategy as the cheapest means of keeping the peace.

On his Paris headquarters map he showed us the hundreds of bases, units, radar points, fuel pipelines, communications facilities, etc., ringing the Iron Curtain, a visual display that brought full-scale meaning to the NATO elements we visited in Europe and the Middle East . . .

The new strategic fields in Spain; the fighter-bomber squadrons in Italy; the well-trained wings in Greece's Royal Hellenic Air Force; the hard-hitting Turks; the growing West German Air Force destined to be a small-but-potent NATO fist.

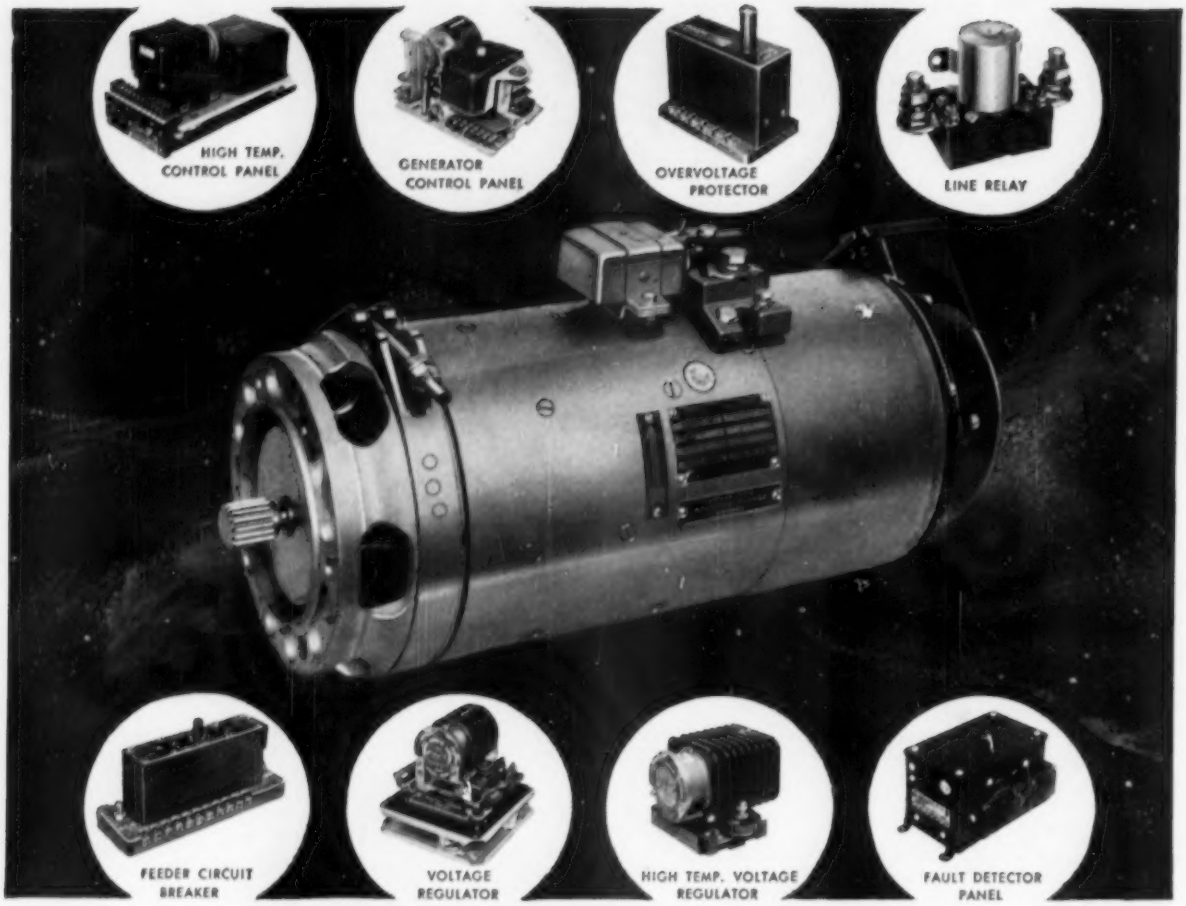
And the briefing gave particular meaning to the role in free world safety played by the U.S. Air Forces in Europe. We visited two of the three: The 17th headquartered in Libya, North Africa, and mantling the Mediterranean NATO countries; and the 12th, guarding sensitive Central Europe on direction from headquarters in Ramstein, Germany.

We saw the strength, the aircraft, the facilities, the training in these massive organizations. We saw their operations and talked with their pilots and commanders, and not one of us failed to mark them down as among the hottest fighting teams in the world—not just in skill, but in pride and restrained aggressiveness that bode ill for the Soviet if they are ever turned loose!

We saw Matador missiles launched in training over the Libyan Desert, and we saw Super Sabres rack up beautiful direct hits on distant targets with high-angle toss and over-the-shoulder atomic attack techniques. We saw swept-wing F-100's on minute-by-minute alert in Central Europe—saw them scramble in fast precision and roar east toward the Iron Curtain just seven jet minutes away.

I was fortunate enough to cruise the curtain in a jet—along the Czechoslovakian and East German borders—and saw the contrails of MIG-17's paralleling us like grim watchdogs.

I could feel the tension. Over there it's real and menacing. You live with it. Just next door.



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30E16	100	2500-4500	50,000	40	52B6588
30B33*	100	4700-8000	35,000	28	MIL-S-9181
30E07	200	3350-8000	50,000	45	AN-3632
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30E02	300	3450-8500	25,000†	64	—
30B37	300—Class C 400—Class A	4000-8000	65,000	53	—
30E10	400	3100-8000	60,000	67	AN-3624
30B34	400	3100-8000	60,000	67	—
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is obtained primarily by phase comparison of the f beatnote of the received F_1 and F_2 signals with the f signal derived within the Dectra receiver by the dividing down of F_1 or F_2. This provides an indication of constant range along a hyperbola whose foci are the two master stations.

Secondary Method

A secondary method of obtaining range is included in the receiver for periods when reception of the F_1 or F_2 signal is too poor to provide accurate two-signal range information. This system employs a high-stability crystal oscillator in the airborne equipment which is used to produce a frequency reference for phase comparison with whichever master station signal is being received.

The airborne Dectra installation consists of:

- **Flight Log**
- **Two control boxes:** one provides receiver controls, the other Flight Log controls.
- **Three Decometers,** plus a range meter.

One of the Decometers serves as the track indicator for Dectra; all three are used for navigation by Decca.

Tracking System

The tracking system of the receiver can be switched either to the track pattern transmitted at frequency F_1 (stations A and B of the illustrations) or F_2 (stations C and D).

In normal operation the receiver will be set to the frequency of the closer chain.

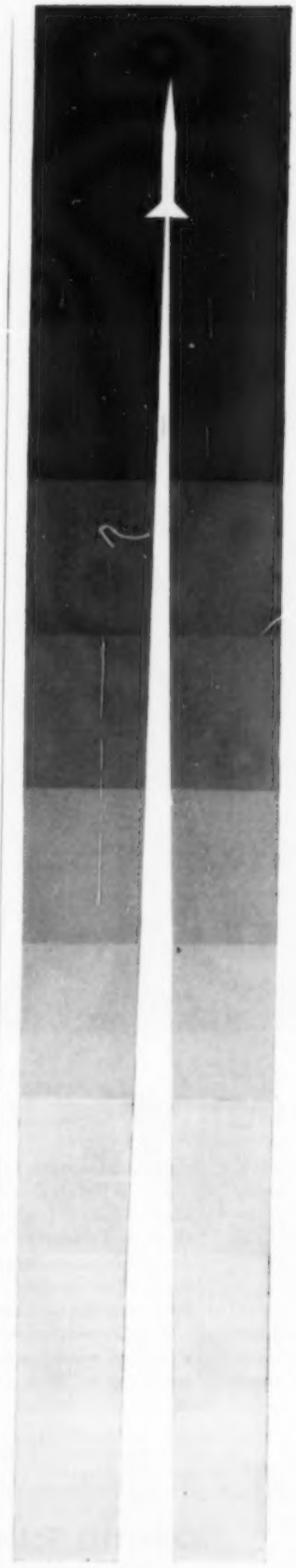
When F_1 is the received signal, one channel controls the phase of an F_1 oscillator while a second channel acts as a switching circuit for the intervals when the slave is transmitting so that the phase of the controlled oscillator and the slave signal can be compared by a discriminator.

The output of the discriminator causes the track meter or the Flight Log to indicate the aircraft's position line in the track pattern. The time constants of the display devices insure an apparently continuous indication.

Measuring Distance

The two-signal ranging system is the primary method by which the receiver measures range. It requires the reception of the master station signals of both chains. If, as above, the receiver is set to F_1, the output of the phase-controlled oscillator is divided down to obtain the subharmonic f of the master signal. The phase of the f signal is compared with the F_1-F_2 beatnote of the master signals by a discriminator as described above.

The hyperbolic pattern to which the discriminator responds has a lanewidth



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corresponding to one discriminator cycle of phase based on the frequency of the undivided signal because the compared values of f are derived in one case from the phase of the F_1 transmitter and in the other case from the two-signal beatnote.

Poor Reception

For periods when the reception of either master station transmission is too poor to provide accurate range information, the receiver's stable crystal oscillator is used to generate the missing F_1 or F_2.

In each case a constant range indication is obtained which occurs along a circle centered on the master station being received.

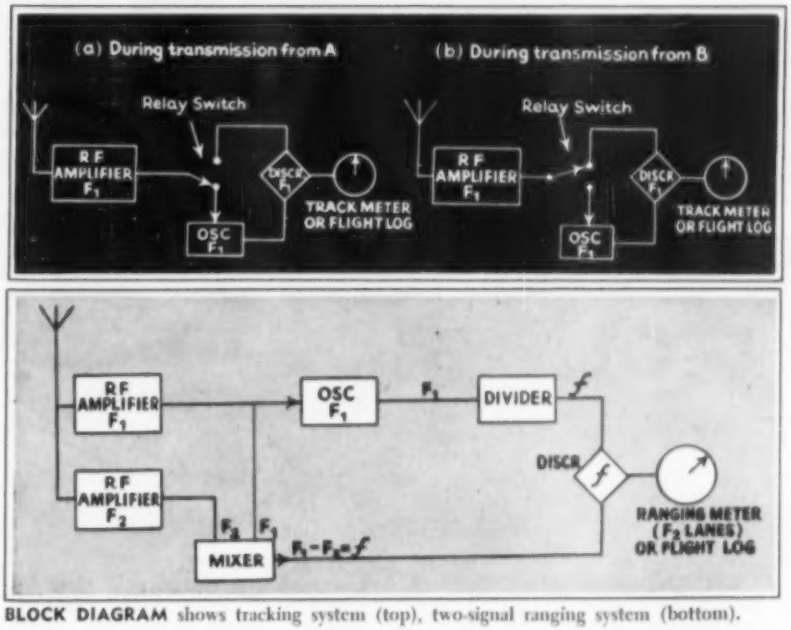
The output of the range discriminator drives a servo feed unit which imparts a "flywheel" effect to the servo motor, maintaining the speed of rotation during momentary losses of signal. A drive selector follows the servo feed unit which automatically selects single-signal ranging upon loss of either master station signal. The outputs of both ranging systems are stored and can be compared with a velocity comparator. The drift of the single-signal range oscillator can be corrected during periods of two-signal reception by matching the outputs of the two ranging systems.

The contemplated Dectra installation at Prestwick requires the relocation of a slave of the North British Decca chain from Newcastle to a site near Stirling and an exchange of slave frequencies to make this the purple slave of the chain. A great circle lying along the median hyperbola laid down by this station and the Decca master station (Dectra slave) at Kidsdale passes approximately seven miles south of the Prestwick and Gander Airports. The Prestwick Dectra chain operates on the purple frequency of Decca Group 3 (F_1 = 70.5375 kc).

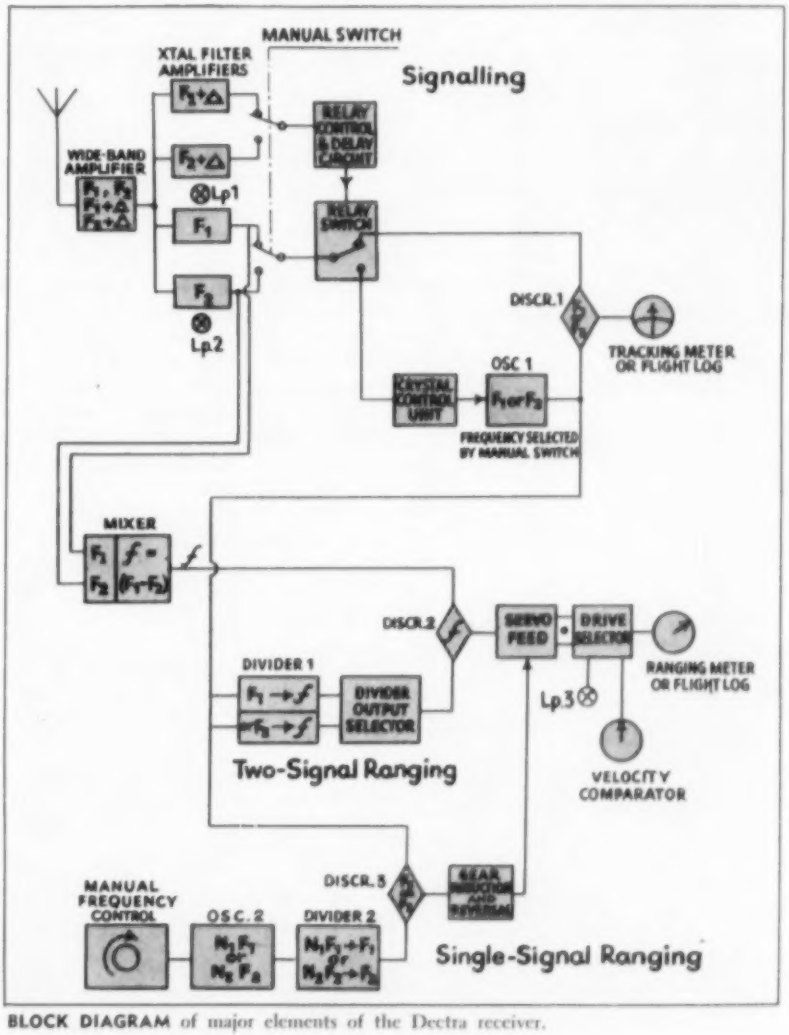
Dectra Sites

The Dectra sites in Newfoundland are at Comfort Cove (Dectra master) on the north coast and at Thorburn Lake (Dectra slave), approximately five miles south of Port Blanford. This chain operates on the purple frequency of Decca Group 2 (F_1 = 70.384 kc). The frequencies F_1 and F_2 are therefore the 460th and 459th harmonics of a frequency f = 153,342 cycles. The F_1 frequency will be controlled by reception of the Comfort Cove station at Kidsdale where it will regulate the master station crystal of the North British chain.

During the early tests the Dectra transmitters are being operated at 12 kw; however, they are capable of a maximum power output of 21 kw if test results indicate the increased power is required.



BLOCK DIAGRAM shows tracking system (top), two-signal ranging system (bottom).



BLOCK DIAGRAM of major elements of the Dectra receiver.

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Cutler-Hammer Leadership in Aircraft Control

Cutler-Hammer has long held the respect of the aircraft industry because this company has been *part* of the aircraft industry for 35 years. It has never been an opportunist supplier. It has *pioneered* the designs others have followed. It has sought to serve, not merely sell. It has been in the forefront of all cooperative activity in standardization and long-range planning. It has supplied complete lines of equipment, not merely the items of widest use and most profitable manufacture. Today, as for the decades past, Cutler-Hammer engineers are working closely with the aircraft industry's leaders . . . thinking ahead, planning, designing and building for the future. Here is the record:

1920 Cutler-Hammer designed and manufactured the first line of switches ever created specifically for use in aircraft.

1938 Cutler-Hammer designed and manufactured the first d-c power relays ever created specifically for use in aircraft.

1943 Cutler-Hammer designed and manufactured the first a-c power relays ever created specifically for use in aircraft.

1949 Cutler-Hammer started development of the first environment-free power relays for use in aircraft.

1953 Cutler-Hammer submitted samples and certified test reports on the first hermetically sealed power relay to WADC and Bu. Aer. Cutler-Hammer configuration was adopted as industry standard by ASG.

1955 Cutler-Hammer designed and manufactured the first one hole mounting Lever Lock aircraft switches.

CUTLER·HAMMER
AIRCRAFT CONTROL
C·H

FILTER CENTER

▶ **Germany Re-enters Radar Field**—Three medium-range radars, for use in air traffic control at Munich, Frankfurt and Hanover, are under construction by German AEG subsidiary of Telefunken. Radars, which will have a range of about 140 miles, are the first of this type to be developed in Germany since postwar restrictions on such activity were lifted. Completion is slated for early 1958.

▶ **Capacitor Capacity**—Micamold Electronics division of General Instrument Corp. has received Signal Corps contract to develop techniques and facilities for mass production of new types of miniaturized tantalum capacitors.

▶ **Speedy Circuit Checker**—Automatic circuit checker which can test 1,200 different aircraft electrical circuits for shorts, opens and reversed wiring in less than a minute has been developed by Republic Aviation Corp. Tester automatically runs through sequence of circuit checks, stops when it finds a faulty circuit and identifies circuit by an indicating light. Republic plans to manufacture and market the device in five models, with capacities for 100, 200, 400, 800 and 1,200 circuits.

▶ **Transparent Phosphors on View**—General Electric's new transparent phos-

Noise Chamber

High-intensity noise room permits testing of avionic equipment under noise levels up to 145 db. which simulate those encountered in jets and missiles in flight. Developed by Radio Corporation of America, the noise room is available in two sizes: 9 x 9 x 24 in. and 36 x 18 x 72 in. Noise chamber can generate white noise over operating frequency range of 20 to 10,000 cps.

What's going on up there?
American Electronic's new 300 KC Band Width RECORDATA magnetic recording system gives an accurate, permanent record.
Specifically designed for recording data from satellites, missiles or other projects where extreme accuracy is required, RECORDATA offers a new concept in reliability and versatility. This sixteen channel system with its modular construction offers many unique features. For example, the six standard tape speeds of 1⅞, 3¾, 7½, 15, 30 and 60 inches per second can be instantly selected with a single switch without changing belts or pulleys. Special speeds to 240 inches per second are also available. Automatic controls assure constant tape tension from beginning to the end of the reel, regardless of size.
Quickly interchangeable tape guides accommodate ¼" ½" or 1" tapes. The plug-in magnetic head assemblies are extremely accurate and provide data tracks with the best electrical uniformity. Where fidelity and reliability are necessary in a data recording system you can depend on RECORDATA . . . manufactured by American Electronics whose Concertone Hi-Fi tape recorders have been famous as quality leaders. Write to Dept 31Je for complete technical information.
AMERICAN ELECTRONICS INC.
655 W. Washington Blvd.
Los Angeles 15, California
Have you heard about the wonderful Engineering opportunities at AMERICAN?

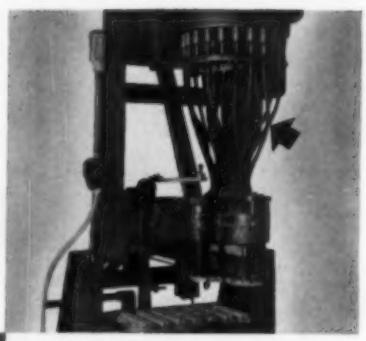
S.S.White

Flexible Shafts Step Up Design Efficiency

The manufacturer of this multiple spindle drill press finds that S.S. WHITE FLEXIBLE SHAFTS allow a wide range of positions for different drilling jobs.

This is only one example of the versatility . . . efficiency . . . and freedom S.S. WHITE FLEXIBLE SHAFTS are bringing to hundreds of industrial designs. The restrictions imposed by rigid shafting are eliminated. With flexible shafts you position power sources . . . driven members . . . controlled parts to better advantage. By simplifying methods of connection and adapting, costs can be reduced. Assembly is cheaper . . . alignment problems are eliminated . . . and product efficiency is often greatly improved!

Consider your own product. Chances are, S.S. WHITE FLEXIBLE SHAFTS are the simple, economical answer to your power drive and control problems. S.S. WHITE FLEXIBLE SHAFTS are noted for quality, performance and dependability. For more information and expert assistance in selecting and applying an S.S. WHITE flexible shaft to your product, just write to

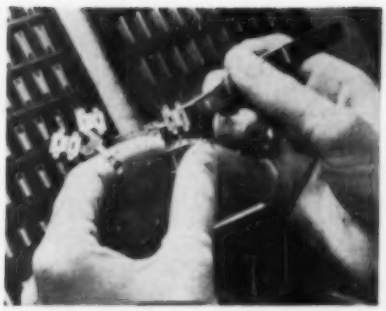


S.S.White

FIRST NAME IN FLEXIBLE SHAFTS

USEFUL DATA on how to select and apply flexible shafts! Write for Bulletin 5601.

S. S. White Industrial Division, Dept. V, 10 East 40th St., New York 16, N. Y. Western Office: 1839 West Pico Blvd., Los Angeles 6, Calif.



Magnetic Timesaver

Small magnet attached to finger ring speeds assembly of vacuum tubes at General Electric's Owensboro, Ky., plant. Ring holds tiny parts, saving operator from reaching into bins for each part. GE estimates magnetic ring speeds up assembly by 12%.

phors, which can be applied in molecular thicknesses to cathode ray tube screens permitting spot and line resolutions approaching the diameter of the electron beam without the two or three-fold enlargement obtained in powdered phosphor screens, will be displayed at the Western Electronics Convention (Wescon), Aug. 20-23, in San Francisco. GE also will display an S-band voltage tunable magnetron, type GL-6917, rated 0.5 watt for continuous-wave operation.

► **U. S. Assistance**—Packard-Bell Electronics Corp. will supply technical assistance to the Toyo Communication Equipment Co., Ltd., of Kawasaki, Japan, which will manufacture airborne IFF (identification, friend or foe) equipment currently being produced by Packard-Bell for the Air Force.

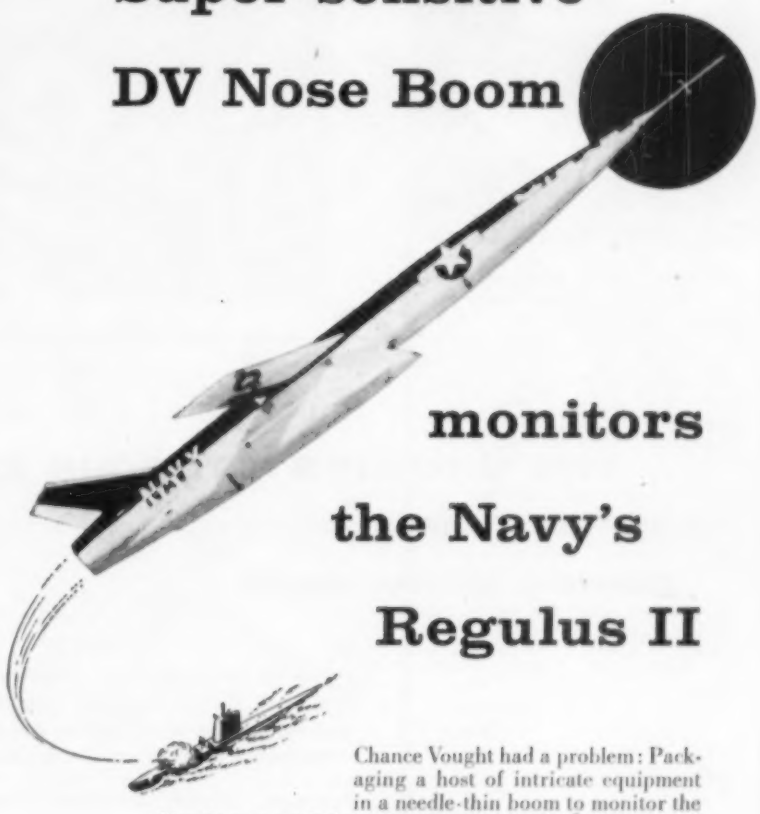
► **Lear ADF's To Germany**—German Air Ministry has placed $600,000 order for automatic direction finders with Lear Electronic GmbH, Munich, subsidiary of Lear, Inc. German Air Force has ordered Lear Model ADF-14D and newer transistorized ADF-100.

► **Calling All Authors**—Third annual Symposium on Aeronautical Communications, to be held in Utica, N. Y., Nov. 6-8, is seeking authors to give technical papers. Classified papers (Confidential) will be presented at closed session on Nov. 8. Interested persons should send unclassified 250-word abstract, indicating whether paper itself will be classified, to Robert A. Zachary, General Electric, 901 Broad St., Utica, N. Y., before Aug. 1.

► **New Arinc Microwave**—Motorola microwave system has been purchased by Aeronautical Radio Inc. for remote control of 20 high frequency transmitters located seven miles from the Seattle-Tacoma, Wash., airport.

Another **DALMO VICTOR** *achievement*

Super-sensitive DV Nose Boom monitors the Navy's Regulus II



Chance Vought had a problem: Packaging a host of intricate equipment in a needle-thin boom to monitor the Navy's new guided missile, Regulus II. This "packaging" was additionally complicated by the requirement that to conserve storage space on board a submarine, the boom must fold pneumatically by remote control.

Dalmo Victor's engineering skill, acquired through development of airborne radar scanner designs, provided the answer!

The ten-foot DV pitot static boom, as accepted by the Navy, meets these most exacting design requirements and provides vital data, including airspeed and altitude, as well as angles of attack and yaw.

Long-recognized leader in airborne radar antennas, Dalmo Victor now applies its experience and skills to create missile components. Contact the nearest DV office for help in solving similar problems.

DALMO VICTOR COMPANY

Division of Textron Inc.

BELMONT, CALIFORNIA

SALES: Dayton, Los Angeles, Washington

FIELD SERVICE: Baltimore, Belmont

Reeves
INSTRUMENT CORPORATION

salutes

THE UNITED STATES AIR FORCE

upon the occasion of its

golden anniversary

Engineering and production of precision electronic equipment and systems for the UNITED STATES AIR FORCE is the day-in, day-out concern of many hundreds of people and many specialized departments in the Reeves organization. We take personal pride, therefore, in saluting this great Service upon the occasion of its Golden Anniversary.

Among the many significant projects currently being advanced at Reeves for the United States Air Force are the following:

- REAC® Electronic Analog Computers for the largest and most advanced installation of its kind at Wright Air Development Center.
- REAC® Electronic Analog Computer installations at White Sands Proving Grounds, Rome Air Development Center, Edwards, Eglin and Holloman Air Force Bases.
- Reeves MSQ Close Support Control Mobile Radar Systems.
- Reeves Range Instrumentation Radar installations at Patrick AFMTC.
- Reeves Military Radar equipment in a wide range of special types for USAF installations throughout the world.
- Reeves special computer systems for gunfire control and many other applications.

In addition to participation in these USAF projects and manufacture of a wide range of precision electronic components for USAF suppliers, Reeves' research and engineering plays a continuing role in the advancement of vital projects for the other Services.

Reeves
INSTRUMENT CORPORATION

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A Subsidiary of Dynamics Corporation of America
215 East 91st Street, New York 28, N.Y.

16RV57

Talos Blends Guidance Systems

Beam-rider in initial phase of its attack, Navy's Talos missile differs in guidance from its predecessor, Terrier, in using a semi-active homing system in final phase, possibly ground radar signals reflected off target. Firing was at White Sands Proving Ground, N. M.

Rafax Adds Link for Control Area Radar

New York—Controllers of the New York Air Route Traffic Control Center are evaluating a remote radar display system, called Rafax, that has made possible the integrated presentation of their long-range AN/FPS-8 radar display with that of the two surveillance radars at Idlewild and LaGuardia.

With improved air traffic control and increased safety for the fast-coming commercial jet age as the goal, the Civil Aeronautics Administration will be conducting extensive tests of the system over the next two months for its Technical Development and Evaluation Center at Indianapolis.

Rafax provides for the transmission of video signals over standard commercial telephone lines. Although wide-band transmission systems such as microwave links or coaxial cable are simpler and provide better definition, they are considerably more costly. A commercial microwave link of suitable quality would rent for about $1,000 per mile each month as opposed to a $16 per mile/month rental for a Class A telephone line used with Rafax.

The Rafax system is a development of Haller, Raymond and Brown, Inc. of State College, Pa., a division of Topp Industries, Inc. According to Robert P. Gira, Topp vice president, a number of Rafax systems are in military use.

Rafax, according to its developers, will extend the radar coverage possible for the traffic controllers by permitting the presentation of displays from radars located remotely throughout their control area. This would mean more positive control of air traffic and permit more rapid acquisition of arriving aircraft, thus reducing the controller's dependence on pilot's position reports.

The Rafax system will, in addition, reduce the clutter present on center radar scopes and eliminate the "overhead" blind spot of the local radar.

AIRCRAFT INSTRUMENTS

FOR PRECISION PLUS

Check the proper box and enclose with your name and address if you want more information on the complete line of aircraft instruments offered to military, commercial, and business aviation by General Electric's Instrument Department at West Lynn, Mass. Return to Section 586-13, General Electric Company, Schenectady 5, N. Y.

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Ammeters · Auto-parallel Systems Testers
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Thermocouples · Thermocouple Assemblies
Thermisters

☐ **COMPONENTS**
Position Elements · Servo Motors
Speed Elements · Gyro Motors

*U.S. NAVY F8U-1 (Chance Vought) is guided by General Electric's MA-1 Compass System, because it offers two outstanding features: (1) free gyro drift rate of only 3° per hour with latitude compensation, and (2) operational stability from −55°C to +71°C.

GENERAL ELECTRIC

AIRCRAFT TUBING

GOVERNMENT SPECIFICATION TUBING IN STOCK..

4130 GRADE		4135 GRADE	1025 GRADE
• AMS - 6371	• AN-T-69	• AMS - 6372	• MIL-T-5066
• MIL-T-6736	• AN-WW-T850a	• MIL-T-6735	• AN-WW-T846

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Performance features of TORRINGTON CAM FOLLOWERS

Heavy sectioned outer race to absorb high rolling and shock loads.

Integral stud for cantilever mounting, case-hardened, with tough core for high strength to withstand shock loads.

Easily relubricated at either end or through cross hole in stud. Ends accommodate standard drive grease fittings or plug seals.

Full complement of small diameter rollers for maximum radial capacity and efficient anti-friction performance.

Races precision ground for even load distribution and uniform low end play.

Built to "FOLLOW THROUGH" under high shock loads

Every feature of the Torrington Cam Follower is designed to insure efficient performance and long service life under heavy rolling and shock loads in cam or track follower service.

Precision made throughout, Torrington Cam Followers are available in sizes from ½" to 2¼" OD. Special surface finishes such as chrome and cadmium plate or oxide black can be provided.

Our engineering staff will be glad to work with you in applying these reliable units to your cam-controlled or track-type equipment. You can depend on Torrington Cam Followers to "follow through" on the job because every element is designed for ultimate capacity. *The Torrington Company,* Torrington, Conn.—and South Bend 21, Ind.

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District Offices and Distributors in Principal Cities of United States and Canada

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • BALL • NEEDLE ROLLERS • THRUST

1958 U. S. Airport Aid Available

Federal money became available this month for 334 airport improvement projects in the Fiscal 1958 Federal-Aid Airport Program, the third of four such programs authorized by Congress.

Funds for the continental United States, including every state but Wisconsin and Wyoming, amount to $52,265,226. An additional $2,770,000 is provided for the Territories. Matching local funds are available or will be provided.

The projects in the Fiscal 1958 program by state and territory:

1958 FEDERAL-AID AIRPORT PROGRAM
($63,000,000 Appropriation)

ALABAMA

Birmingham $1,000,000
City of Birmingham
Municipal Airport
Site preparation and utilities for building; construct administration building; land acquisition—clear zones.

Dothan 72,500
City of Dothan
Municipal Airport
Land acquisition—clear zones and runway extension; extend and light runway extension 1100'.

Huntsville 71,000
City of Huntsville and County of Madison
Huntsville Airport
Land acquisition—clear zone north end N/S runway; enlarge administration building.

Tuscaloosa 153,500
City of Tuscaloosa
Van De Graaff Airport
Pave N/S runway 5000' x 150'; pave taxiway; install lights; construct administration building; relocate power line; fence.

TOTAL $1,297,000

ARIZONA

Coolidge $8,021
Town of Coolidge
Municipal Airport
Construct NE/SW runway 2600' x 50', taxiway and apron.

Douglas 19,642
County of Chochise
Bisbee-Douglas
Internat'l. Airport
Reconstruct taxiways.

Flagstaff 51,824
City of Flagstaff
Municipal Airport
Construct parallel taxiway.

Phoenix 570,013
City of Phoenix
Sky Harbor Airport
Land acquisition—clear zones both ends runway 8L-26R; widen main ramp.

Prescott 101,243
City of Prescott
Municipal Airport
Resurface NE/SW runway and taxiway.

Scottsdale 146,660
Town of Scottsdale
Municipal Airport
Construct NW/SE runway 4200 ft. x 75 ft., taxiway and apron; install medium intensity runway lights; fencing; construct entrance road and auto parking area.

Tucson 67,210
Tucson Airport Authority
Municipal Airport
Fencing; land acquisition—partial clear zone NE end NE/SW runway; site preparation—terminal area.

TOTAL $964,613

ARKANSAS

Forrest City $19,500
City of Forrest City
Municipal Airport
Land acquisition—airport development; construct N/S landing strip 3000 ft. x 250 ft.

Gurdon 6,750
City of Gurdon
Municipal Airport
Land acquisition—clear zones and airport development; construct NE/SW runway 2500 ft. x 50 ft., taxiway and apron.

Rogers 16,750
City of Rogers
Municipal Airport
Land acquisition—clear zones and airport development; site preparation; fencing; construct aprons and entrance road.

Russellville 40,000
City of Russellville
Russellville Airport
Land acquisition—clear zones and airport development; site preparation; pave E/W runway 3000 ft. x 50 ft., apron and taxiway.

TOTAL $83,000

CALIFORNIA

At Tahoe $78,005
County of El Dorado
Tahoe Valley Airport
Land acquisition—airport development; site preparation—N/S landing strip 6100 ft. x 300 ft.

Arcata 14,089
County of Humboldt
Arcata County Airport
Construct taxiway and extend terminal apron.

Bakersfield 186,294
County of Kern
Bakersfield-Kern
County No. 1 Airport
Fencing; extend taxiway and apron including site clearance; construct well and extend water main to terminal area; construct auto parking area.

Beckwourth 5,148
County of Plumas
Beckwourth Airport
Install medium intensity runway lights on primary runway.

Fortuna 11,502
County of Humboldt
Rohnerville County Airport
Construct taxiway.

Fresno 37,514
City of Fresno
Chandler Municipal Airport
Land acquisition—clear zone NW end primary runway.

Fullerton 135,478
City of Fullerton
Municipal Airport
Land acquisition—clear zones primary runway; construct and light primary runway 2500 ft. x 75 ft. and parallel taxiway.

Garberville 6,069
County of Humboldt
Garberville County Airport
Pave runway 2200 ft. x 50 ft., and taxiway.

Hayward 16,761
City of Hayward
Municipal Airport
Construct water line.

Los Angeles 1,250,000
City of Los Angeles
Los Angeles Internat'l. Airport
Construct ramp and taxiways.

Monterey 32,514
Monterey Peninsula
Airport District
Monterey-Peninsula Airport
Land acquisition—clear zone SE end of primary runway.

Oakland 1,250,000
City of Oakland
Metropolitan Oakland
Internat'l. Airport
Construct sub-base for primary runway and taxiway; construct administration building and control tower.

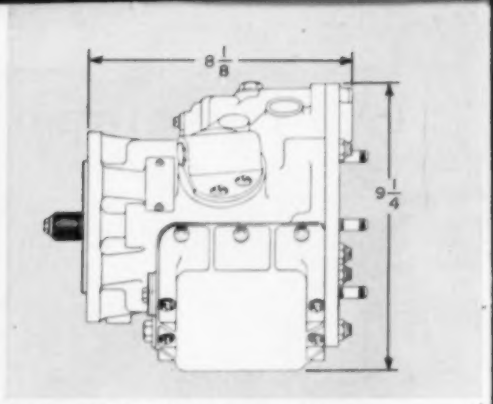
Ontario 352,234
City of Ontario
Ontario Internat'l. Airport
Reconstruct primary runway and parallel taxiway including warm-up pads; relocate perimeter entrance road.

Oxnard 180,290
County of Ventura
Ventura County Airport

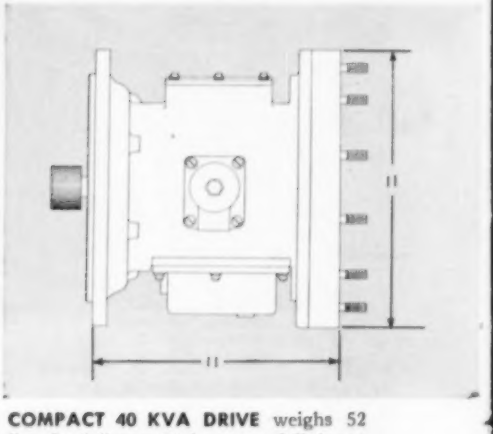
Low-Cost Hangar at Baltimore

Steel hangar recently dedicated at Friendship International Airport, Baltimore, cost less than $10 per sq. ft. to build. Usual hangar cost is about $40 sq. ft. The low-cost structure built by Luria Engineering Co. measures 200 x 300 ft., is stressed for 90 mph. winds.

MECHANICALLY SIMPLE ball piston unit shown being assembled in 20 KVA drive replaces conventional cylindrical pistons, connecting rods and bearings. Its use results in a more compact, lighter weight constant speed drive with fewer moving parts.



LIGHTWEIGHT 20 KVA DRIVE weighs 35 lbs. It delivers rated 32 hp over full input speed range of 4300 to 8300 rpm.



COMPACT 40 KVA DRIVE weighs 52 lbs. It delivers 63 hp over full input speed range of 3700 to 8300 rpm.

GENERAL ELECTRIC DEVELOPMENT SHOWS

How Ball Pistons Cut Size and Weight, Simplify Hydraulic Drive Design

General Electric Hydraulic Constant Speed Drives offer outstanding space and weight savings and design simplicity for any 400-cycle a-c electric system. You can combine these drives with any aircraft generator for use on piston, turboprop, or turbojet engines.

UNIQUE BALL PISTON DESIGN is the key to the small size, lightweight and mechanical simplicity of these drives. Operating on the simplest of principles, this radial piston hydraulic transmission uses precision steel balls in place of pistons, connecting rods and bearings. Extensive testing and thousands of hours of operational flying have proven this unit maintains high efficiency and reliability.

FEWER MOVING PARTS are required with this design. For example, since the balls are free in the cylinder and roll on the race, no separate bearings are needed to prevent contact friction, and the usual piston and connecting rod bearings are eliminated. The use of a journal bearing further cuts size and complexity. What's more, the mechanical governor system, which provides steady state speed control within ±1%, is an integral part of the transmission. Easily accessible parts simplify maintenance.

COMPACT AND SELF-CONTAINED, a typical 20 KVA drive measures only 8⅛ inches long and 9¼ inches in diameter. It weighs 35 lbs. A typical 40 KVA drive measures 11 inches by 11 inches and weighs 52 lbs.

Fine frequency control to ±1/10% and automatic paralleling can be provided with all General Electric Hydraulic Constant Speed Drives. For more information on these drives contact your General Electric Aviation and Defense Industries Sales Office, or send coupon for bulletins.

Section F218-15, General Electric Co.
Schenectady 5, New York

Please send me the following hydraulic constant speed drive bulletins:

- ☐ **Descriptive bulletin, GEA-6274**
- ☐ **Theory of Operation, GET-2480A**
- ☐ **immediate project** ☐ **reference only**

Name .....

Position .....

Company .....

City ..... **State** .....

Progress Is Our Most Important Product

GENERAL ELECTRIC

Land acquisition—partial clear zone west end of primary runway and airport development.

Paso Robles **24,386**
County of San Luis Obispo
Paso Robles Airport
Construct taxiways.

Porterville **10,838**
City of Porterville
Municipal Airport
Land acquisition—clear zone NW end of primary runway.

San Francisco **766,246**
City of San Francisco and County of San Francisco
San Francisco Internat'l. Airport
Site preparation for extension of north end of runway 19L; construct taxiways.

San Jose **191,779**
City of San Jose
Municipal Airport
Land acquisition—clear zones; relocate power line and lighting controls; pave apron; construct water and fire line to control tower.

Santa Ana **40,642**
County of Orange
Orange County Airport
Land acquisition—complete clear zone primary runway.

Santa Barbara **71,511**
City of Santa Barbara
Municipal Airport
Land acquisition—partial clear zone E end primary runway.

Santa Monica **20,771**
City of Santa Monica
Municipal Airport
Construct taxiway and ramp.

Stockton **67,737**
County of San Joaquin
Stockton Field
Land acquisition—clear zones primary runway.

Weed **10,838**
County of Siskiyou
Weed Airport
Land acquisition—clear zones and construction of N/S landing strip 3500 ft. x 250 ft.

TOTAL **$4,755,643**

COLORADO

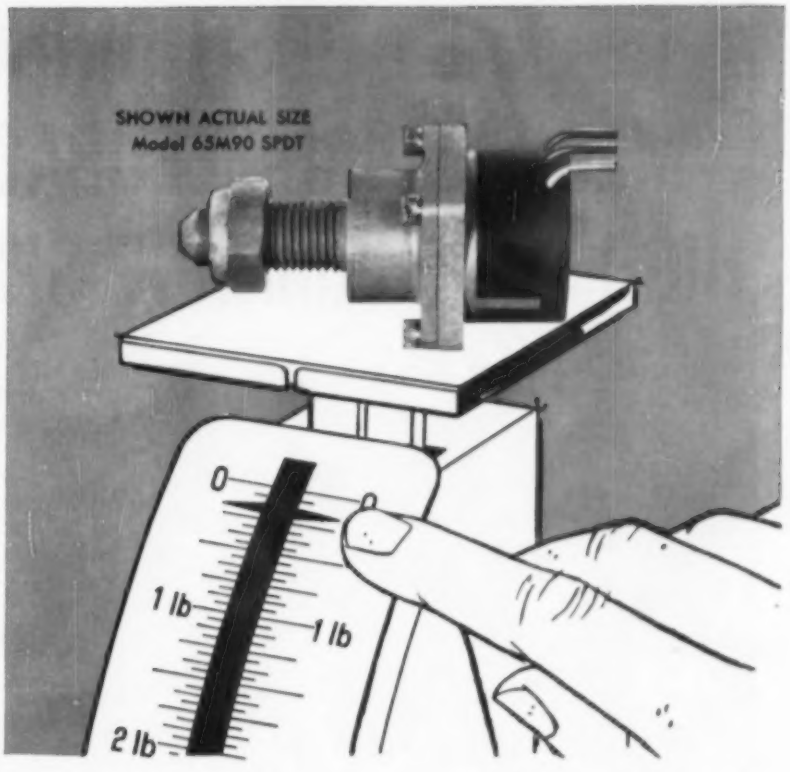
Alamosa **$5,325**
City of Alamosa and County of Alamosa
Municipal Airport
Additional surfacing of NNE/SSW runway 1000 ft. x 100 ft.

Boulder **39,937**
City of Boulder
Municipal Airport
Pave runway 4200 ft. x 100 ft. taxiway and apron; construct administration building.

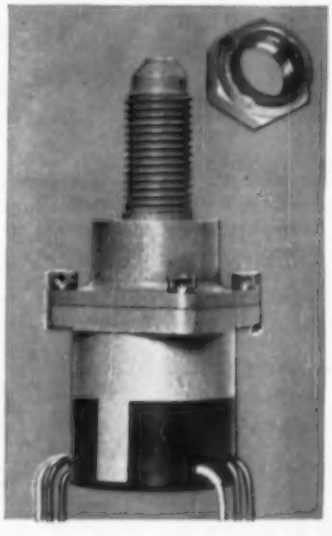
Cortez **24,300**
City of Cortez and County of Montezuma
Montezuma County Airport
Surface NNE/SSW runway 5900 ft. x 100 ft., taxiways and apron.

Grand Junction **140,163**
City of Grand Junction and County of Mesa
Walker Field
Extend NW/SE runway to 6400 ft.; install runway lights.

Monte Vista **16,614**
City of Monte Vista
San Luis Valley Airport
Complete paving of NNE/SSW



NOW...TRUE MINIATURIZATION IN PRESSURE CAPSWITCHES



SHOWN ACTUAL SIZE
Model 65M91 DPDT

New Bridgeport Pressure CAPSWITCHES for aircraft, rockets and missiles are small enough to be grouped on 1.09" centers. Switch heads are enCAPsulated in epoxy resin, assuring constant switch settings and repeatability. Rugged piston actuators in these bulkhead mounting units are insensitive to vibration fatigue and rapid temperature cycling.

- Pressure settings: 20 to 500 psi
- Proof pressure: 2300 psi (piston bottomed against mechanical stop)
- Fluids: combustion gases, fuel, oil, H_2O_2, helium, etc.
- Temperature: —65° to +275°F.
- Life: 20,000 cycles minimum
- Weight: 65M90 (SPDT) .150 lbs.
  65M91 (DPDT) .220 lbs.

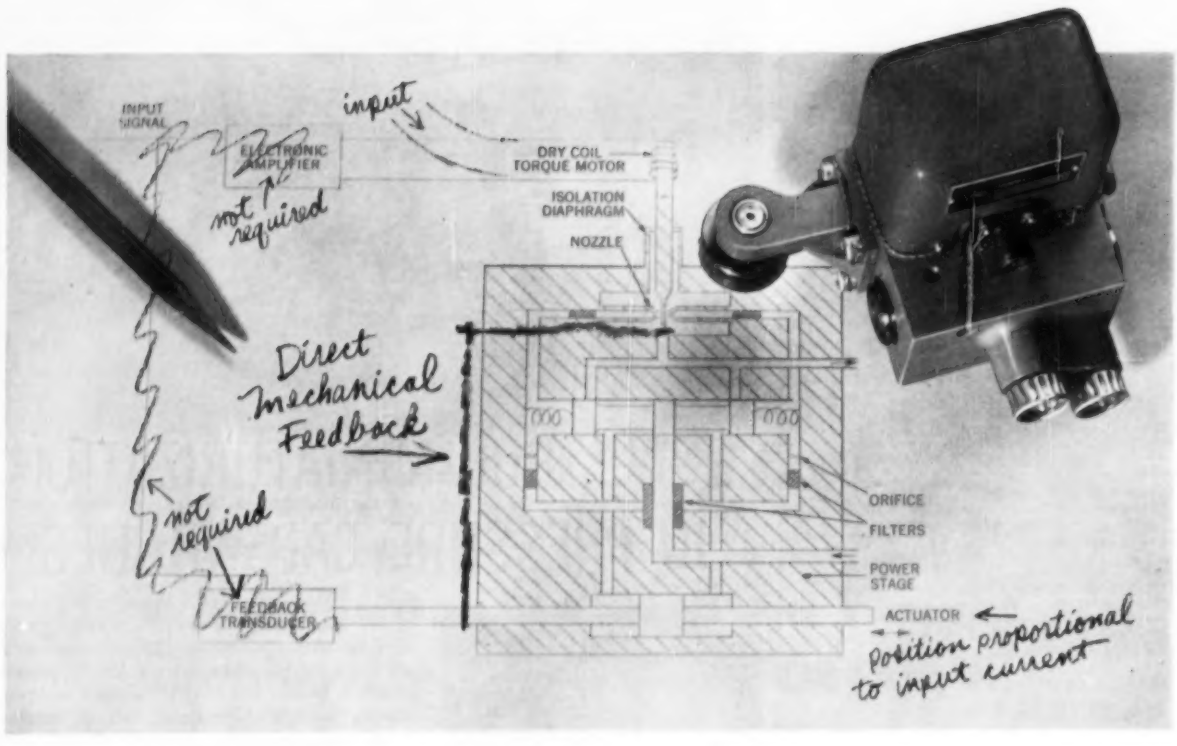
Write for complete information on our line of pressure CAPSWITCHES.

Mr. Controls

Robertshaw-Fulton CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION • MILFORD, CONN.

EXACT POSITIONING WITH MECHANICAL FEEDBACK IN NEW HIGH PERFORMANCE SERVO SYSTEM



Hydraulic Research's new integrated electro-hydraulic servo valve – actuator combination eliminates amplifier and electrical feedback by the addition of a mechanical feedback spring and increased servo valve gains.
This mechanical spring feedback loop provides a considerably lower time constant, and essentially infinite resolution. Also, greater reliability and lower costs result.

The unit illustrated above has a ¼" stroke with .16 watt electrical error input. It is in production. The design may be modified to any desired stroke, with inputs of .06 watts and lower. Hydraulic Research's new servo system design utilizes a basic dry coil torque motor servo valve. It is compact, lightweight, and adaptable to any application where precise positioning is required.

Developers and manufacturers of the "Hydomal"—compact multiple input servo package.

Write for complete information

HYDRAULIC RESEARCH
AND MANUFACTURING COMPANY
Subsidiary of Bell Aircraft Corp.
2835 N. Naomi Street • Burbank, Calif. • Victoria 9-2227

PRECISION HYDRAULIC VALVES AND COMPONENTS FOR FLIGHT CONTROL SINCE 1943

runway 3000 ft. x 100 ft.; land acquisition—airport development.

TOTAL **$223,339**

CONNECTICUT

Danbury **$50,000**
Town of Danbury
Municipal Airport
Install medium intensity lights NE/SW runway; land acquisition—partial clear zones NE/SW runway and NW/SE runway.

Groton **12,500**
State of Connecticut
Trumbull Field
Pave apron; install security fence.

Meriden **20,000**
City of Meriden
Meriden Airport
Construct N/S runway 2300 ft. x 75 ft.

Stamford **102,500**
City of Stamford
Stamford Heliport
Land acquisition; site preparation.

Windham **10,000**
Town of Windham
Windham Airport
Land acquisition—partial clear zone.

Windsor Locks **150,000**
State of Connecticut
Bradley Field
Expand administration building.

TOTAL **$345,000**

DELAWARE

Wilmington **$29,000**
County of New Castle
New Castle County Airport
Construct taxiway and building for airport maintenance equipment.

TOTAL **$29,000**

FLORIDA

Daytona Beach **$105,000**
City of Daytona Beach
Municipal Airport
Extend runway No. 6-24, 700 ft.; extend high intensity runway lighting; strengthen runway No. 6-24 and taxiways; land acquisition—west clear zone.

Fort Lauderdale **172,000**
County of Broward
Broward County
Internat'l. Airport
Construct administration building, custom building and utilities; land acquisition—clear zone.

Fort Myers **21,000**
County of Lee
Page Field
Remodel building for CAA and Weather Bureau; land acquisition—clear zone NE/SW runway.

Fort Pierce **6,800**
County of St. Lucie
St. Lucie County Airport
Install medium intensity runway lights; construct apron.

Lakeland **25,000**
City of Lakeland
Drane Field
Land acquisition—clear zone NE/SW runway.

Miami **1,250,000**
Dade County Airport
Authority
Miami Internat'l. Airport
Construct terminal apron; ex-

25 YEARS EXPERIENCE IN THE MANUFACTURE OF PRECISION PARTS FOR THE AIRCRAFT INDUSTRY

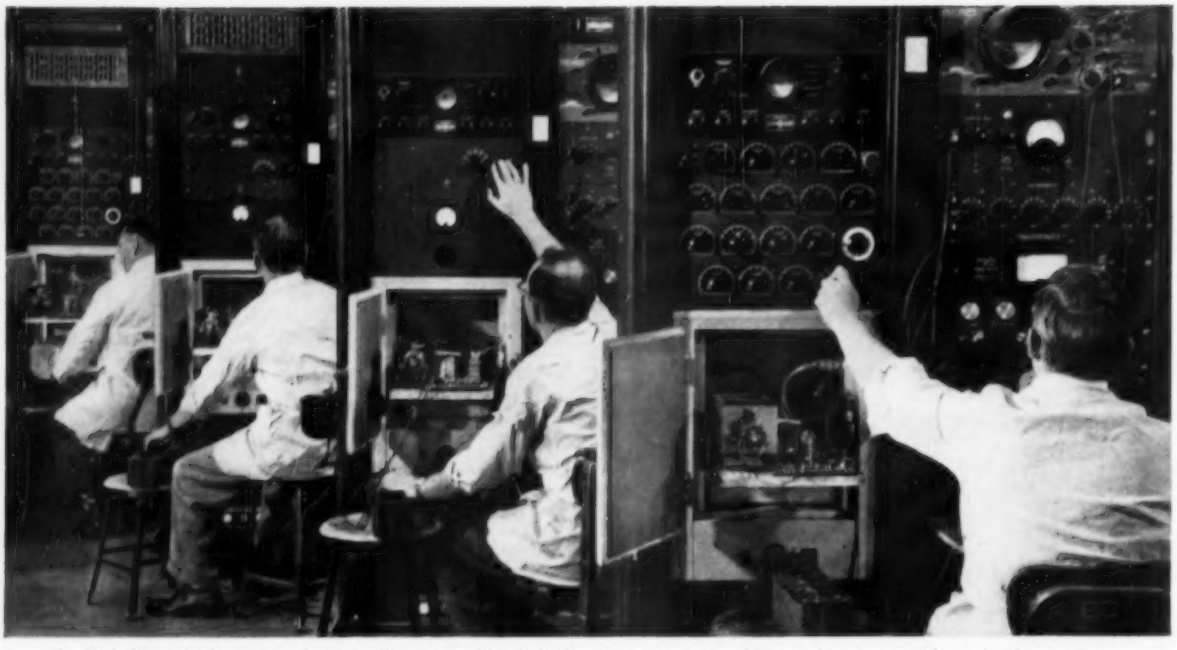
In this, Diecraft's 25th Anniversary Year, we have the cumulative experience, the modern plant and machinery and the highly skilled people that can meet the greatest challenges of close tolerance, precision production.

Our wealth of experience has been in manufacture of precision parts for AIRCRAFT, GUIDED MISSILES, ELECTRONICS & ORDNANCE.

We are handling the toughest of production problems for leaders in these industries. Let us apply our specialized knowledge and skill to solve *your* procurement problems.

DIECRAFT, INC.

8343 PULASKI HIGHWAY, BALTIMORE 21, MARYLAND
TELEPHONE: MURDOCK 6-3390



Bendix-built production test equipment calibrates precision induction rate generators and temperature compensating networks as a team.

GET FAST DELIVERY ON HIGH PRECISION RATE GENERATORS AT BENDIX "SUPERMARKET"

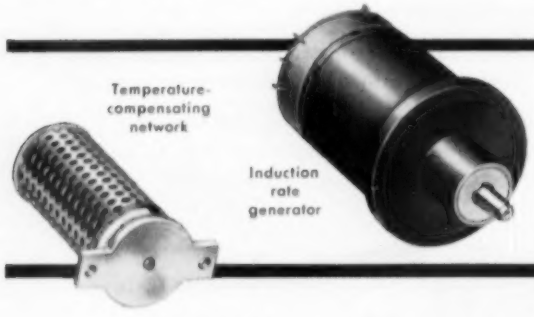
You're used to fast delivery at minimum cost from the Bendix Synchro "Supermarket", but maybe you don't know that this applies to such specialized, high-precision equipment.

The photo above shows the extensive production facility used to test Bendix induction rate generators and temperature-compensating networks as a matched pair. It's your assurance that precision rate generators you buy from Bendix will have the accuracy of laboratory-built instruments. Yet we produce them at almost assembly-line speed.

Extensive calibration enables us to promise generator accuracy within .15 of 1 per cent up to 3,600 rpm, unmatched in a production model such as this. Actually, at 4 volts and 3,000 rpm—the range at which the instrument will more commonly operate—linear accuracy is even greater: within .05 of 1 per cent.

District Offices: Burbank and San Carlos, Calif.; Dayton, Ohio; Seattle, Wash.

Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.



AVERAGE ELECTRICAL CHARACTERISTICS

Rated excitation	115 volts, 400 cycles
Output voltage gradient	2 volts per 1000 rpm
Output voltage	6 volts ± 0.05% at 3000 rpm
Phase shift	0 ± 0.1 degrees

AVERAGE MECHANICAL CHARACTERISTICS

Rotor moment of inertia	0.57 oz.-in.^{2}
Operating temperature range	-15°C. to 75°C.
Weight:	
Rate generator	1⅜ pounds
Compensating network	¼ pound

Eclipse-Pioneer Division
TETERBORO, N. J.

Bendix
AVIATION CORPORATION

tend administration building and construct 5th loading dock.

Orlando **350,000**
City of Orlando
Municipal Airport
Construct NE/SW runway 5000 ft. x 150 ft.; grade, drain new taxiways.

Panama City **87,500**
Panama City Airport Board
Fannin Field
Construct, light and mark taxiways.

Pensacola **165,000**
City of Pensacola
Municipal Airport
Land acquisition—Clear zones; relocate hangar; enlarge control cab.

St. Petersburg **92,000**
County of Pinellas
Pinellas County
Internat'l. Airport
Land acquisition—clear zone; extend N/S runway 700 ft.; construct taxiway segments; marking.

Tallahassee **400,000**
City of Tallahassee
Municipal Airport
Construct N/S runway 5700 ft. x 150 ft., E/W runway 4700 ft. x 150 ft. including taxiways and apron.

Tampa **77,500**
County of Hillsborough
Tampa Internat'l. Airport
Install medium intensity lights E/W runway; construct taxiway; extend parking ramp.

TOTAL **$2,751,800**

GEORGIA

Albany **$87,500**
City of Albany and
County of Dougherty
Municipal Airport
Relocate transformers and beacon; construct new vault; remove old buildings and construct new administration building.

Americus **18,900**
City of Americus and
County of Sumter
Souther Field
Pave NE/SW runway 3000 ft. x 75 ft.

Athens **37,000**
County of Clarke
Municipal Airport
Construct administration building and connecting taxiway.

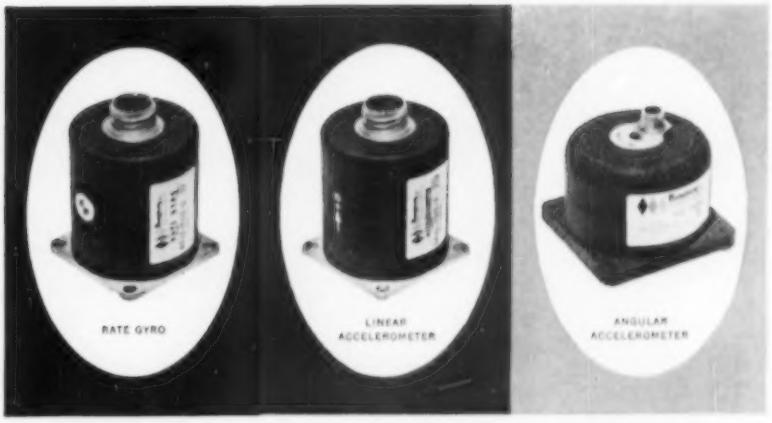
Atlanta **1,250,000**
City of Atlanta
Municipal Airport
Completion—1st stage apron and concourses; construct 2nd stage administration building.

Brunswick **62,000**
County of Glynn
Malcolm-McKinnon Airport
Land acquisition—clear zones and for new NW/SE runway.

Columbus **40,000**
County of Muscogee
Muscogee County Airport
Reconstruct NE/SW and NW/SE runways and taxiways.

Douglas **24,750**
City of Douglas
Municipal Airport
Pave NE/SW runway 3500 ft. x 75 ft.

TOTAL **$1,520,150**



Advanced Instrumentation by Humphrey

New production inertial sensing instruments for extra precision and reliability

Among the outstanding features of Humphrey's new inertial sensing instruments are: dry helium filled, hermetically sealed steel cases; standardized mountings for rate gyro and linear accelerometer; and choice of regular AN connector or new pigmy connector.

RATE GYRO is of new simplified design, with light-weight efficient motor, accurate trouble-free damping, and choice of inductive or potentiometer pick-off.

LINEAR ACCELEROMETER is of dual contra-rotating mass design. It has practically zero sensitivity to cross acceleration and angular acceleration; ± symmetrical or asymmetrical ranges (0 to 1G) to (0 to 100G).

ANGULAR ACCELEROMETER is compactly designed with completely symmetrical inertial ring. Available ranges are from zero to ± ½ rad/sec² to zero to 100 rad/sec.² Except in very low range, either potentiometer or inductive pick-off can be furnished. Performance for either instrumentation or control systems is excellent.

FOR COMPLETE SYSTEMS, SPECIFY HUMPHREY GYROSCOPES, ACCELEROMETERS, POTENTIOMETERS

Rate Gyro—Model RG15-0102-1: New simplified design with light-weight efficient motor.

Linear Accelerometer—Model LA15-0501-1: Zero sensitivity to cross and angular acceleration.

Angular Accelerometer—Model AA01-0207-1: Excellent performance for instrumentation or control systems.

Humphrey Inc.
ELECTRO-MECHANICAL INSTRUMENTS
Dept. A-7
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COMPANY _____
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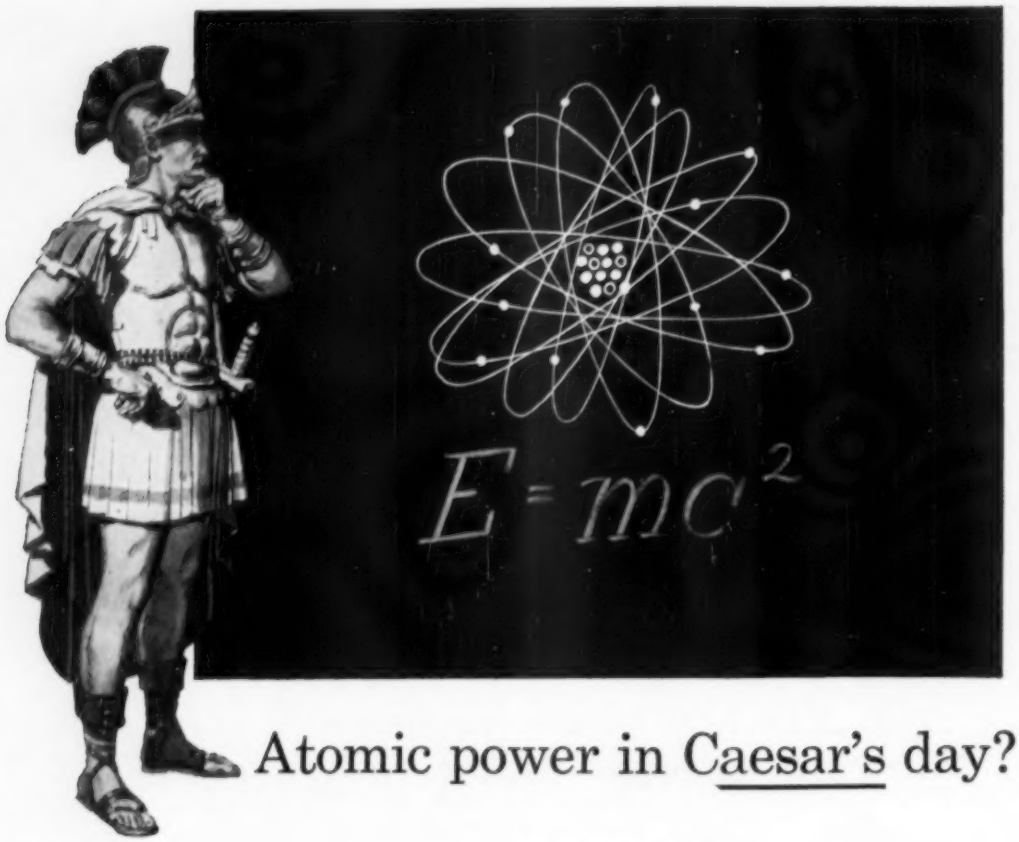

Atomic power in Caesar's day?

Certainly!

It was there, in the ground, in the air and water. It always had been. There are no more "raw materials" today than there were when Rome ruled the world.

The only thing new is knowledge . . . knowledge of how to get at and rearrange raw materials. Every invention of modern times was "available" to Rameses, Caesar, Charlemagne.

In this sense, then, we have available *today* in existing raw materials the inventions that can make our lives longer, happier, and inconceivably easier. We need only *knowledge* to bring them into reality.

Could there possibly be a better argument for the strengthening of our *sources* of knowledge—our colleges and universities? Can we possibly deny that the welfare, progress—indeed the very *fate*—of our nation depends on the quality of knowledge generated and transmitted by these institutions of higher learning?

It is almost unbelievable that a society such as ours, which has profited so vastly from an accelerated accumulation of knowledge, should allow anything to threaten the wellsprings of our learning.

Yet this is the case

The crisis that confronts our colleges today threatens to weaken seriously their ability to produce the kind of graduates who can assimilate and carry forward our rich heritage of learning.

The crisis is composed of several elements: a salary scale that is driving away from teaching the kind of mind *most qualified* to teach; overcrowded classrooms; and a mounting pressure for enrollment that will *double* by 1967.

In a very real sense our personal and national progress depends on our colleges. They *must* have our aid.

Help the colleges or universities of your choice. Help them plan for stronger faculties and expansion. The returns will be greater than you think.

If you want to know what the college crisis means to you, write for a free booklet to: HIGHER EDUCATION, Box 36, Times Square Station, New York 36, New York.

HIGHER EDUCATION

KEEP IT BRIGHT

PUBLIC SERVICE ADVERTISING COUNCIL

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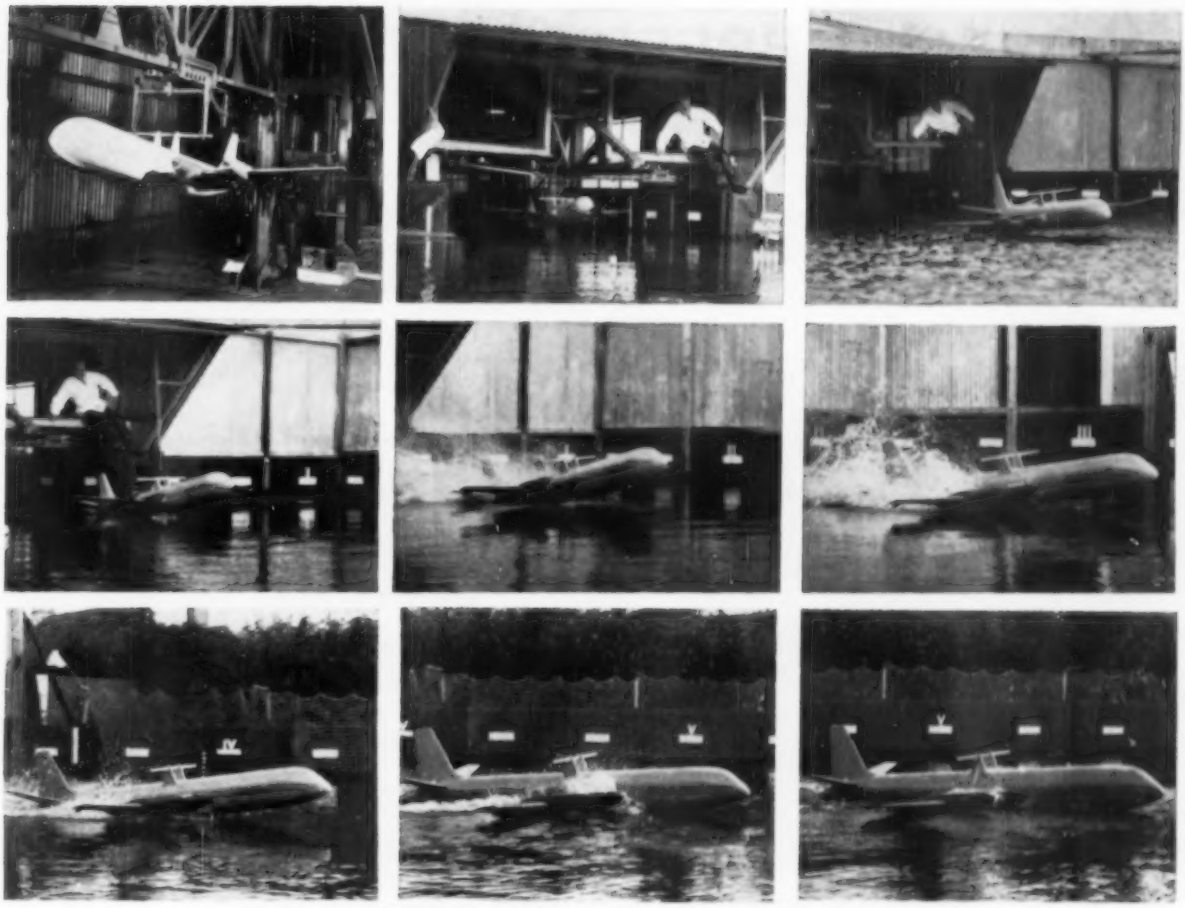


Ditching Vanguard Model

Photo sequence, left to right, shows ditching test on model of Vickers-Armstrongs' 63-ton, 120-passenger Vanguard. Tests in Saunders-Roe Free Landing Tank covered both calm and rough water. Model has movable flaps and elevators; all dimensions are to correct scale. Total weight is representative of full-scale value. Flaps, freight-loading doors and tailplane were made so they would fail at scale loads. Loads encountered during ditching were recorded by accelerometers fitted inside model.

IDAHO

Twin Falls $55,720
City of Twin Falls
Municipal Airport (Joslin Field)
Extend and light E/W runway to 5906 ft.

TOTAL $55,720

ILLINOIS

Alton-East Alton $25,000
Civic Memorial Airport Authority
Civic Memorial Airport
Construct administration building.

Aurora 259,000
City of Aurora
Municipal (New) Airport
Land acquisition—airport development and clear zones; construct and light WNW/ESE runway 3500 ft. x 75 ft., taxiway and apron; fencing; construct entrance road and auto parking area.

Champaign-Urbana 160,000
University of Illinois
University of Illinois Airport
First unit of administration building including tower and utilities.

Chicago 1,250,000
City of Chicago
O'Hare Field—
International Airport
Extend runway 14L-32R, 655 ft. and relating taxiway; land acquisition airport development; pave split finger "F"; construct second unit of maintenance building.

Chicago 232,500
City of Chicago
Midway Airport
Land acquisition and avigation easements for lead-in lights; strengthen runway 13L-31R, 4856 ft. x 150 ft. and runway 4L-22R, 4857 ft. x 150 ft.

Danville 40,000
Vermilion County Airport Authority
Vermilion County Airport
Land acquisition—N/S clear zones; extend apron, enlarge administration building.

Dixon 21,500
City of Dixon
Municipal Airport
Construct taxiways No. 2, 4 and 5; fencing; extend apron.

Fairfield 38,000
City of Fairfield
Municipal Airport
Land acquisition—clear zones and reimbursement; construct N/S runway 2000 ft. x 60 ft., taxiways and apron.

Flora 51,800
City of Flora
Municipal Airport (New)
Land acquisition—airport development and clear zones; construct runway 2500 ft. x 60 ft., taxiway, apron, entrance road and auto parking area.

Galesburg 52,500
City of Galesburg
Municipal Airport (New)
Install medium intensity lights NE/SW runway; land acquisition—clear zones E/W runway and airport development; extend and widen apron; construct taxiway No. 3, entrance road and auto parking area.

Harrisburg-Raleigh 22,000
Harrisburg-Raleigh Airport Authority
Harrisburg-Raleigh Airport
Extend NE/SW runway 1000 ft.

Mount Vernon 5,000
Mount Vernon Airport Authority
Municipal Airport
Land acquisition—clear zone NW/SE runway.

A SPECIAL BREED OF CAT...

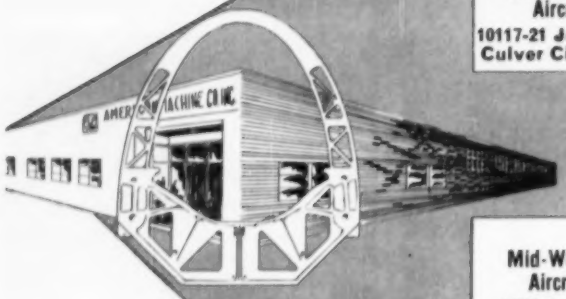
are the aircraft parts of today

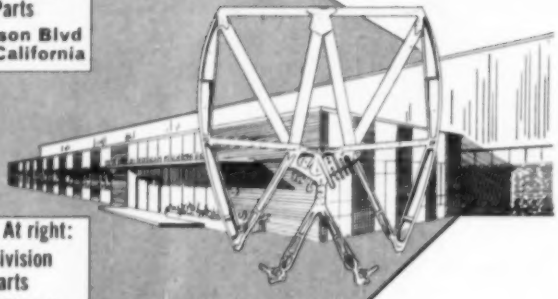
...and the divisions of H & B American Machine Co., Inc. offer you the specialized skills and equipment needed to produce these parts on schedule and of the highest quality.

Convair F-102-A

2 DIVISIONS TO SERVE YOU

At left:
West Coast Division
Aircraft Parts
10117-21 Jefferson Blvd
Culver City, California

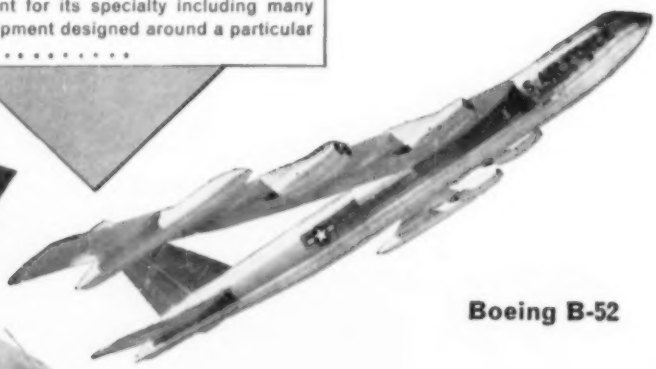




At right:
Mid-West Division
Aircraft Parts
1450 E. 19th Street
Indianapolis, Indiana

Illustrated above are typical structural machined aircraft parts and assemblies currently being manufactured in the two divisions. The aircraft divisions operate under Air Force approved Quality Control systems. Each division possesses the most up-to-date equipment for its specialty including many pieces of equipment designed around a particular part. . . . . .

Convair B-58



Boeing B-52

H&B AMERICAN MACHINE CO., INC.

General Offices: Prudential Plaza, Chicago 1, Illinois

Olney-Noble **91,000**
Olney-Noble Airport Authority
Olney-Noble Airport (New)
Land acquisition—airport development and clear zones; construct and light runway 2500 ft. x 60 ft., taxiway and apron; fencing; construct entrance road and auto parking area.

Peoria **$176,500**
Greater Peoria
Airport Authority
Greater Peoria Airport
Construct and light taxiways; construct water main; install power supply; construct entrance road and auto parking area.

Rockford **25,000**
Greater Rockford
Airport Authority
Greater Rockford Airport
Install taxiway lighting.

Salem **10,000**
Salem Airport Authority
Salem-Leckrone Airport
Install lighting N/S runway; widen taxiway.

Springfield **260,000**
Springfield Airport Authority
Capitol Airport
Land acquisition—clear zones NE/SW and NW/SE runways; enlarge administration building; expand terminal apron.

West Chicago **201,750**
County of DuPage
DuPage County Airport
Construct and light EW runway 4000 ft. x 75 ft. and taxiways.

TOTAL **$2,921,250**

INDIANA

Anderson **$42,500**
City of Anderson
Municipal Airport (New)
Acquire site and clear zones.

Bloomington **46,825**
City of Bloomington
Municipal Airport
Land acquisition—clear zones; resurface NE/SW runway; construct administration building.

Crawfordsville **20,000**
City of Crawfordsville
Municipal Airport
Acquire easements; construct NE/SW runway 2800 ft. x 60 ft.; pave taxiway.

Evansville **16,000**
City of Evansville
Dress Memorial Airport
Pave aprons.

Frankfort **54,125**
City of Frankfort
Frankfort Airport
Land acquisition—airport development and clear zones; construct N/S 2215 ft. x 300 ft. and E/W 3560 ft. x 300 ft. strips and taxiways.

Gary **85,000**
City of Gary
Municipal Airport
Land acquisition—clear zones; enlarge administration building.

Indianapolis **26,200**
City of Indianapolis
Municipal Airport
Land acquisition—partial clear zone.

Kokomo **25,250**
City of Kokomo
Municipal Airport
Install runway lights, wind tee and beacon; construct plane parking ramp, entrance road, auto parking areas and taxiways; fencing.

PIONEERING IS OUR BUSINESS

CONVAIR SELECTS BENDIX LIQUID OXYGEN SYSTEM FOR B-58 HUSTLER—

America's First Supersonic Bomber

The B-58 is built to fly at supersonic speeds at altitudes ranging above 50,000 feet. It is described as a high-performance medium bomber for big missions—a new concept in aircraft design.

The same applies to the equipment packed in its compact structure—vital equipment like the Bendix* liquid oxygen converter system that supplies life-giving oxygen to its three-man crew.

Size and weight must meet rigid specifications—with no compromise in reliability and performance. The liquid oxygen equipment provided by Bendix—pioneer in the development of liquid oxygen systems—combines these essentials, plus the know-how gained in more than a quarter century of experience as a major producer of airborne oxygen equipment for military, commercial, executive and private aircraft.

No matter what your oxygen requirements may be—either airborne or industrial—Bendix is prepared to serve you. Pioneer-Central Division, Bendix Aviation Corporation, Davenport, Iowa. *REG. U.S. PAT. OFF.

West Coast Office: 117 E. Providencia, Burbank, Calif.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

INDICATOR—Capacitance Type Liquid Oxygen Quantity Totalizing

CONVERTER—Liquid Oxygen Converter, 5 liter

Pioneer-Central Division
DAVENPORT, IOWA

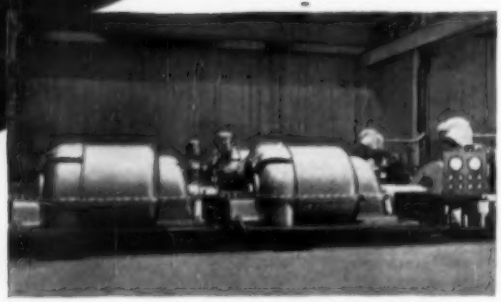
Bendix
AVIATION CORPORATION

High pressure centrifugal air compressors for engine test. The two units in foreground operate in parallel and furnish air to high pressure unit in background.

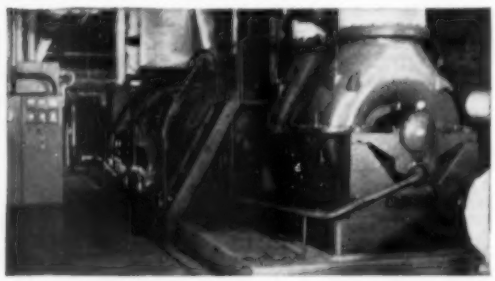
ALLIS-CHALMERS COMPRESSORS

for every aviation test need

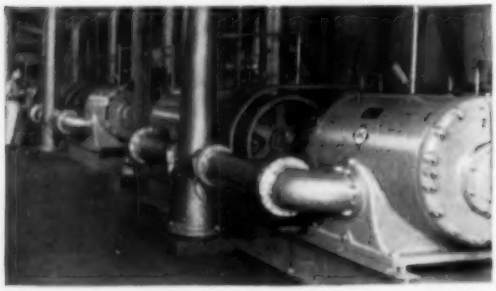
ALLIS-CHALMERS has installed compressor equipment totalling nearly 600,000 hp . . . 8,000,000 cfm in aviation test facilities including wind tunnels, and engine and component testing. This is your assurance of highly experienced assistance during design, installation and operating stages. Whatever your problem, call the A-C office in your area or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.



Engine test exhausters. One of several tandem-driven centrifugal gas exhauster sets in an eastern aircraft engine plant.



Ram air compressors. Two axial compressors driven by single motor are installed in a midwestern aircraft plant. Allis-Chalmers builds all sizes of axial compressors for small or large wind tunnel installations and other applications.



Altitude simulation and component testing with vacuum pumps. This long line of single-stage rotary units is installed in an aviation test laboratory in the Midwest.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Michigan City $17,250
City of Michigan City
Municipal Airport
Land acquisition—runway extension; reconstruct and extend NE/SW runway to 3400 ft.; install lighting NE/SW runway; reconstruct entrance road.

Mount Vernon 39,000
City of Mount Vernon
Municipal Airport
Land acquisition—airport development; site preparation.

Newcastle 106,200
City of Newcastle
Municipal Airport
Acquire site and clear zones; construct E/W runway 3500 ft. x 75 ft.

Terre Haute 109,409
City of Terre Haute
Hulman Municipal Airport
Strengthen NW/SE runway; extend taxiway; construct apron.

Wabash 12,000
City of Wabash
Municipal Airport
Acquire site and clear zones; grade and drain; fencing; water supply and turfing.

TOTAL $599,759

IOWA

Algona $8,500
City of Algona
Municipal Airport
Acquire clear zone easements; page NW/SE runway 2200 ft. x 50 ft. and taxistrip to runway.

Clinton 8,640
City of Clinton
Municipal Airport
Construct taxiway.

Creston $14,400
City of Creston
Municipal Airport
Acquire clear zone easements and airport site; construct N/S landing strip and building area, entrance road and auto parking area; fencing.

Des Moines 399,405
City of Des Moines
Municipal Airport
Construct and light new NE/SW runway 5000 ft. x 150 ft. and apron.

Forest City 12,000
City of Forest City
Municipal Airport
Land acquisition—clear zones N/S runway; obstruction removal; grade and mark N/S runway 2000 ft. x 250 ft., building area and entrance road; fencing; land acquisition—airport development.

TOTAL $442,945

KANSAS

McPherson $24,000
City of McPherson
Municipal Airport
Land acquisition—airport expansion and clear zone.

Salina 175,000
City of Salina
Municipal Airport
Extend N/S runway 1200 ft.; install lights N/S runway extension; construct taxiway extension.

TOTAL $199,000

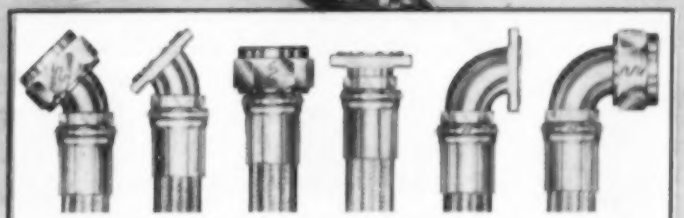
KENTUCKY

Covington $54,641
County of Kenton

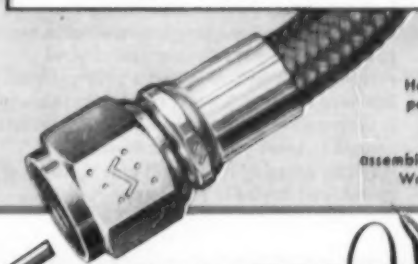
developed for extreme temperature ranges in supersonic jets . . .

Stratoflex "Super-T" hose assemblies are designed for extremely high and low temperatures. Stratoflex "Super-T" tube is extruded from specially compounded Teflon* and reinforced with high strength, corrosion resistant stainless steel wire braid. "Super-T" is unaffected by fuels, petroleum or synthetic base lubricants, acids, solvents, alcohol, and coolants. It is non-inflammable and the shelf and operating life are practically unlimited to provide long and trouble free service.

*TEFLON is a registered DuPont trademark.



Straight 45° and 90° fittings in stock



Stratoflex "Super-T" hose is available in standard sizes from —4 to —20. Hose is factory assembled, fittings permanently attached — corrosion resistant, high temperature or lightweight types. Special assemblies, made to your specifications. Write for information (S-3 Bulletin).

STRATOFLEX Inc.

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Branch Plants: Los Angeles, Fort Wayne, Toronto
In Canada: Stratoflex of Canada, Inc.

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Houston
Kansas City
Los Angeles
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Seattle, Toronto
Tulsa

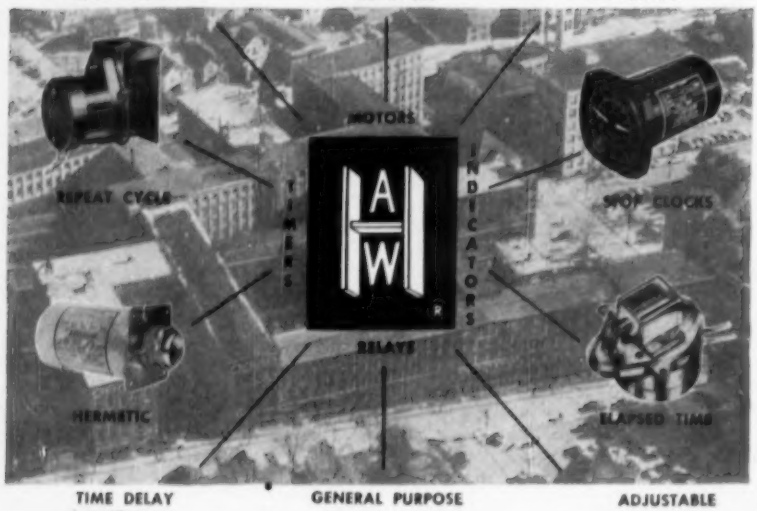
one source for all timers!

• *the*
• **A. W. HAYDON COMPANY**
• *offers a* ***COMPLETE LINE*** *of . . .*
• **STANDARD and CUSTOM DESIGNED TIMING MOTORS and DEVICES!**
• for military and industrial applications. Illustrated are some of these units . . . any can be modified to meet your specific requirements if the basic design is not adequate.

DIRECT CURRENT

400 CYCLE

GOVERNED



TIME DELAY

GENERAL PURPOSE

ADJUSTABLE

Shown below is the new catalog of The A. W. Haydon Company describing all of the basic types of units available and many of the "specials". Included in this 25-page catalog are 60 photographs of timers, 30 dimensional drawings, and 50 charts and diagrams. This complete catalog will be supplied on request.

Long a pioneer in the timing field, The A. W. Haydon Company is prepared to assist you in solving your timing and control problems. When a solution to your problem has been reached, The A. W. Haydon Company is prepared to follow through with production geared to meet your requirements whether a basic timing unit or a highly specialized device is required.

The **A.W.HAYDON** *Company*

222 NORTH ELM STREET, WATERBURY 20, CONNECTICUT

Design and Manufacture of Electro-Mechanical Timing Devices

Greater Cincinnati Airport
Light taxiways; land acquisition—clear zones, N/S and E/W runways.

Elizabethtown **22,000**
Elizabethtown-Hardin County Air Board
Elizabethtown-Hardin County Airport
Land acquisition—clear zones and airport development; construct NE/SW landing strip 2700 ft. x 300 ft., entrance road and auto parking area.

Harlan **32,500**
City of Harlan and County of Harlan
Harlan Airport
Acquire site; develop E/W landing strip 2450 ft. x 250 ft., taxiway and apron; approach clearance.

Hazard **13,100**
County of Perry
Hazard Airport
Acquire site; land acquisition—clear zones.

Hopkinsville **61,681**
City of Hopkinsville and County of Christian
Hopkinsville-Christian County Airport
Acquire site; develop E/W landing strip 4200 ft. x 400 ft.

Lexington **39,000**
City of Lexington and County of Fayette
Blue Grass Field
Construct auto parking area, sewage disposal system, water main and crash fire building.

Louisville **700,000**
Louisville and Jefferson County Air Board
Standiford Airport
Expand administration building including utilities.

TOTAL **$922,922**

LOUISIANA

Baton Rouge **$27,500**
East Baton Rouge Parish
Ryan Field
Reconstruct south taxiway; pave auto parking area; enlarge administration building.

Lake Charles **350,000**
Calcasieu Parish
Municipal Airport
Construct apron; install lighting on NW/SE runway; construct administration building.

New Orleans **1,250,000**
New Orleans Aviation Board
Moisant Internat'l. Airport
Construct main portion of administration building.

TOTAL **$1,627,500**

MAINE

Auburn **$97,500**
Cities of Lewiston and Auburn
Lewiston-Auburn Airport
Land acquisition—clear zones; extend NE/SW runway to 4900 ft.

Augusta **12,500**
State of Maine
State Airport
Construct maintenance building; pave apron.

Eastport **30,000**
City of Eastport
Eastport Airport
Resurface NW/SE runway; improve drainage system.

Saco **$50,000**
City of Saco

AERO COMMANDER OUTSOLD ITS CLOSEST COMPETITOR BY MORE THAN

58%

*IN THE FIRST FIVE MONTHS OF 1957**

Executive transports are bought for one reason only—because they deliver the superior performance demanded by business and industry.

The 7-place Aero Commander outsold its closest competitor by more than 58% in the first five months of 1957 because the COMMANDER DELIVERS TRULY SUPERIOR PERFORMANCE IN EVERY RESPECT. Don't be misled by extravagant advertising claims. Aero Commander is PROVED SUPERIOR IN ACTUAL USE. Check the weight and balance data from any Aero Commander owner's log book against any other twin-engine executive transport in its class. These incontestable figures prove absolutely that Aero Commander provides MORE PAYLOAD . . . GREATER RANGE . . . and HIGHER SPEED.

Your Commander distributor will be pleased to refer you to a Commander owner in your area.

* SOURCE: FIGURES RELEASED BY AIRCRAFT INDUSTRIES ASSOCIATION

AERO Commander

560-E-680-S

AERO DESIGN & ENGINEERING CO
TULAKES AIRPORT • P. O. BOX 118 • BETHANY, OKLAHOMA

MISSILE SYSTEMS FLIGHT DYNAMICS

Weapon systems management activities at Lockheed's Palo Alto, Sunnyvale and Van Nuys organizations demand accomplishment of a high order in flight dynamics areas such as: Analysis of missile dynamic motion and establishment of stability and control system criteria for trajectories with 3 or more degrees of freedom; development of techniques for the analysis and interpretation of flight dynamics test data at hypersonic speeds; study of special dynamics problems arising during preliminary design and development of missile systems. Inquiries are invited. Please address the Research and Development Staff, Sunnyvale 17, California.

Left to right: S. S. Edwards, flight dynamics; B. W. Marsh, aerodynamics; M. Tucker, Aerothermodynamics Department manager; and R. L. Nelson, project aerodynamics, discuss reentry dynamics.

Lockheed

MISSILE SYSTEMS DIVISION

LOCKHEED AIRCRAFT CORPORATION

PALO ALTO • SUNNYVALE • VAN NUYS

CALIFORNIA

Municipal Airport
Land acquisition—clear zones and airport development; construct surface treated runway 2500 ft. x 75 ft., taxiway, plane parking apron, auto parking area and entrance road.

Waterville **13,000**
City of Waterville
Robert A. LaFleur Airport
Construct apron; install lights on NW/SE runway.

Wiscasset **30,000**
Town of Wiscasset
Wiscasset Airport
Land acquisition—airport development; construct turfed landing strip 300 ft. x 2500 ft.; relocate road and power line.

TOTAL **$233,000**

MARYLAND

Baltimore **$93,125**
City of Baltimore
Friendship Internat'l. Airport
Land acquisition—clear zones E/W runway; construct fuel truck parking area.

Ocean City **100,000**
State of Maryland
Ocean City Airport
Land acquisition—clear zones and airport development; construct turfed landing strip 4000 ft. x 300 ft.; install lights.

Rockville **225,000**
County of Montgomery
Montgomery County Airport
Land acquisition—clear zones and airport development; site preparation for primary runway; pave primary runway 4000 ft. x 75 ft., taxiway and apron.

TOTAL **$418,125**

MASSACHUSETTS

Barnstable **$8,300**
Town of Barnstable
Hyannis Airport
Auxiliary generator plant.

Lawrence **30,000**
City of Lawrence
Municipal Airport
Construct taxiway.

Mansfield **8,750**
Town of Mansfield
Municipal Airport
Construct apron and taxiway.

Martha's Vineyard **13,800**
County of Dukes
Martha's Vineyard Airport
Improve shoulders and end zones, runways #6-24 and #15-33.

Nantucket **35,000**
Town of Nantucket
Memorial Airport
Addition to administration building; extend apron.

New Bedford **30,250**
City of New Bedford
Municipal Airport
Install wind tee; construct sidewalk and fencing; grading; obstruction removal.

Norwood **12,000**
Town of Norwood
Memorial Airport
Install lights E/W runway.

Orange **34,700**
Town of Orange
Municipal Airport
Install lights NW/SE runway including hazard beacons.

Pittsfield **$500,000**
City of Pittsfield
Municipal Airport
Land acquisition—clear zones and approach protection; relocate road; construct runway 5200 ft. x 150 ft.

Turners Falls **100,000**
Town of Montague
Turners Falls Airport
Land acquisition—clear zones; construct runway 3000 ft. x 75 ft.; install runway lighting; fencing.

Westfield **23,500**
City of Westfield
Barnes Airport
Addition to administration building; resurface apron at hangar and administration building; construct auto parking area.

Worcester **35,000**
City of Worcester
Municipal Airport
Construct taxiway and additional drainage.

TOTAL **$831,300**

MICHIGAN

Alpena **$20,000**
County of Alpena
Phelps-Collins Airport
Construct administration building.

Battle Creek **50,000**
City of Battle Creek
K. K. Kellogg Regional Airfield
Land acquisition—partial clear zones.

Detroit **1,250,000**
County of Wayne
Detroit-Wayne Major Airport
Construct parallel taxiways, apron and entrance road; install taxiway lighting; construct finger for administration building and customs building.

Detroit **$45,500**
University of Michigan
Willow Run Airport
Land acquisition—clear zones; rehabilitate lighting.

Flint **58,500**
City of Flint
Bishop Field
Land acquisition—clear zones and runway extension.

Gaylord **47,000**
County of Otsego
Otsego County Airport
Land acquisition—clear zones; construct E/W runway 3500 ft. x 75 ft., taxiway and apron.

Grand Rapids **450,000**
County of Kent
Kent County Airport
Construct taxiways and administration building; land acquisition.

Lansing **140,500**
State of Michigan
Capital City Airport
Install administration building utilities; construct entrance road and auto parking area.

Manistee **15,000**
City of Manistee
Manistee-Blacker Airport
Land acquisition—clear zone.

Muskegon **500,000**
County of Muskegon
Muskegon County Airport
Land acquisition—airport development; site preparation; construct ENE/WSW runway 5500 ft. x 150 ft. and taxiways.

Pontiac **68,000**
City of Pontiac
Municipal Airport
Land acquisition for administration building; construct taxiways, pave hangar area and fencing.

South Haven **13,000**
City of South Haven
Municipal Airport
Land acquisition—clear zones and runway extension.

Three Rivers **6,000**

New Boeing Hangar

Eight B-52 bombers or KC-135 tankers can be worked on in the new hangars under construction at Moses Lake, Wash. Old hangar is in background surrounded by B-52s.

Servo Motors For

Transistorized Operations

• Meets MIL-E-5272 • −65°C to +125°C temperature range.

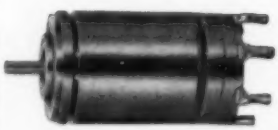
Oster

	SIZE 8	SIZE 10	SIZE 11	SIZE 15	SIZE 18
Oster Type	8-5001-00	10-5052-00	11-5101-00	15-5153-00	18-5201-00
Electrical Characteristics					
Frequency (cps)	400	400	400	400	400
Torque at Stall (oz. in.)	.15	.30	.63	1.45	2.35
No Load Speed (rpm)	6500	6500	6500	5200	5200
Speed at Half Torque (rpm)	4000	4000	4000	3200	3200
Time Constant (sec.)	0.03	0.015	0.016	0.017	0.013
Reversing Time (sec.)	0.051	0.025	0.028	0.030	0.022
Theo. Acceleration at Stall (rad. sec²)	22500	45000	41500	31000	40000
Operating Temp. Range (°C.)	−54 to +125	−54 to +125	−54 to +125	−54 to +125	−54 to +125
Slot Effect	1.6v/26v	1.0v/36v	1.0v/40v	1.0v/40v	1.0v/40v
Duty Cycle	Cont.	Cont.	Cont.	Cont.	Cont.
Fixed Phase					
Voltage	26	115	115	115	115
R (Stall) Ohms	196	1270	1250	490	280
X (Stall) Ohms	183	1560	1780	890	570
Z (Stall) Ohms	268	2210	2175	1030	640
P.F. (Stall)	0.73	0.57	0.58	0.49	0.45
Effective R (Stall) Ohms	366	3840	3800	2160	1460
Parallel Tuning cond. for unity P.F. (Stall) Mfd	1.0	0.13	0.15	0.33	0.55
Control Phase					
Voltage	40/20	40/20	40/20	40/20	40/20
*R (Stall) Ohms	480	124	145	58	39
*X (Stall) Ohms	445	215	204	103	77
*Z (Stall) Ohms	660	248	250	118	86
*P.F. (Stall)	0.73	0.50	0.58	0.49	0.45
*Effective R (Stall) Ohms	910	495	430	240	190
*Parallel Tuning cond. for unity P.F. (Stall) Mfd	0.4	1.4	1.3	2.9	4.1
Mechanical Characteristics					
Rotor Inertia (gm. cm²)	.47	.47	1.07	3.3	4.0
Weight (oz.)	1.2	2	4.5	8	14
Mounting Type	Synchro	Synchro	Synchro	Synchro	Synchro
Motor Length	.863	.672	1.703	1.625	2.03
Type Shaft	Pinion	Pinion	Plain	Plain	Plain
Shaft Extension	.375	.218	.437	.540	.540
Outside Diameter	.750	.937	1.062	1.437	1.750
Type Connection	Leads	Terminals	Terminals	Terminals	Terminals

*For 40v connection

Size 8

Size 10



Size 11

Size 15

Size 18

This complete line can be varied by Oster specialists to your precise requirement. Write today for further information, enclosing detailed data on your needs.

Other products include motor-gear-trains, synchros, AC drive motors, DC motors, servo mechanism assemblies, motor tachs, servo torque units, reference and tachometer generators, actuators, motor driven blower and fan assemblies and fast response resolvers.

John Oster **MANUFACTURING COMPANY**
Your Rotating Equipment Specialist
Avionic Division
Racine, Wisconsin

Engineers For Advanced Projects:
Interesting, varied work on designing transistor circuits and servo mechanisms. Contact Mr. Zelazo, Director of Research, in confidence.

DUSTON GOODWIN ADVERTISING

City of Three Rivers
Dr. Haines Flying Field
Install lighting NE/SW runway.

Traverse City 30,000
City of Traverse City
Traverse City Airport
Acquire easements — primary and secondary runways; obstruction removal.

TOTAL $2,693,500

MINNESOTA

Cloquet $50,000
City of Cloquet
Municipal Airport
Land acquisition—airport development; pave and light runway 3500 ft. x 75 ft.

Duluth 20,301
City of Duluth
Municipal Airport
Land acquisition—clear zones.

Minneapolis-St. Paul 1,250,000
Minneapolis-St. Paul Metropolitan Airports Commission
Wold-Chamberlain Airport
Construct administration building.

Rochester 454,000
City of Rochester
Municipal Airport (New)
Pave NW/SE runway 6500 ft. x 150 ft., NE/SW runway 4000 ft. x 150 ft., taxiways and apron.

Worthington 24,500
City of Worthington
Municipal Airport
Land acquisition—clear zones.

TOTAL $1,798,801

MISSISSIPPI

Columbia $17,000
City of Columbia
Municipal Airport
Construct and light NW/SE runway 3000 ft. x 75 ft.

Kosciusko 40,000
City of Kosciusko and County of Attalla
Kosciusko-Attalla County Airport
Land acquisition—clear zones and airport development; construct runway 3000 ft. x 75 ft.; miscellaneous.

TOTAL $57,000

MISSOURI

Bismarck $11,500
City of Bismarck
Memorial Airport
Land acquisition—airport development; pave N/S runway 2000 ft. x 50 ft.; acquire clear zones.

Kansas City 800,000
City of Kansas City
Mid-Continent Internat'l Airport
Extend N/S runway 3000 ft. and construct taxiway; site preparation—terminal area.

St. Louis 1,040,000
City of St. Louis
Lambert-St. Louis Municipal Airport
Construct parallel taxiways and warm-up pads; extend terminal apron and concourses; enlarge administration building.

West Plains $18,500
City of West Plains
Municipal Airport
Land acquisition—airport development and clear zones; construct runway 3000 ft. x 50 ft.

TOTAL $1,870,000

Air Force Academy

Steel framework for cadet barracks goes up at Air Force Academy in Colorado Springs. First class at permanent site will enroll in September 1958.

MONTANA

Billings $38,900
City of Billings
Municipal Airport
Complete surfacing NNW/SSE runway; construct control tower.

Libby 31,760
U. S. Forest Service
Libby Airport (USFS)
Construct E/W runway 3300 ft. by 75 ft.; fencing.

TOTAL $70,660

NEBRASKA

Burwell $20,000
City of Burwell
Municipal Airport
Land acquisition—airport development and clear zones; construct NW/SE landing strip 2600 ft. x 200 ft., apron, building area, entrance road and auto parking area; fencing.

David City 5,000
City of David City
Municipal Airport
Land acquisition—clear zones; install lights NNW/SSE landing strip.

Gordon 5,000
City of Gordon
Municipal Airport
Land acquisition—clear zones; install medium intensity lights NW/SE landing strip.

Mitchell $30,000
City of Mitchell
Municipal Airport
Land acquisition—clear zones and airport development; prepare site for NW/SE runway; pave NW/SE runway 3500 ft. x 50 ft., taxiway and apron; install runway lights including beacon.

North Platte 8,000
City of North Platte
Lee Bird Field
Land acquisition—clear zone; obstruction removal; install medium intensity lights E/W runway.

Scottsbluff 17,500
City of Scottsbluff
Municipal Airport
Land acquisition—clear zones NW/SE and NE/SW runways; install medium intensity lights NW/SE and NE/SW runways.

Syracuse 20,000
City of Syracuse
Municipal Airport
Land acquisition—airport development and clear zones; construct taxiway, apron, building area, entrance road and auto parking area; fencing.

TOTAL $105,500

NEVADA

Las Vegas $587,013
County of Clark
McCarran Field
Extend and light E/W runway to 10,600 ft. and parallel taxiway; construct stub taxiways; expand terminal apron; land acquisition—airport development.

Reno 390,625
City of Reno
Municipal Airport
Construct taxiways and apron; site preparation—terminal area; construct administration building.

TOTAL $977,638

NEW HAMPSHIRE

Concord $122,500
City of Concord
Municipal Airport
Extend runway 17-35, 1000 ft.; construct parallel taxiway; clearing; relocate high tension line.

Wolfeboro 59,900
Town of Wolfeboro
Lakes Region Airport
Land acquisition—clear zones and airport development; construct runway 2500 ft. x 300 ft.

TOTAL $182,400

NEW JERSEY

Atlantic City $400,000
City of Atlantic City
Municipal Airport (Pomona)
Construct administration building; relocate road and construct auto parking area.

Newark **100,000**
The Port of New York Authority
Newark Airport
Pave and light high-speed taxi turn offs.

Paterson **150,000**
City of Paterson
Paterson Heliport
Site preparation; pave entrance road and auto parking area; fencing.

Trenton **102,800**
County of Mercer
Mercer County Airport
Extend northeast end of NE/SW instrument runway 1200 ft.; light runway extension; pave taxiways.

TOTAL **$752,800**

NEW MEXICO

Albuquerque **$500,000**
City of Albuquerque
Municipal Airport
Land acquisition—airport development; site preparation for runways and taxiways.

Hobbs **62,134**
County of Lea
Lea County Airport (Hobbs)
Extend NE/SW runway to 6400 ft.; light runway extension; construct and light taxiway.

Lovington **90,241**
County of Lea
Lea County Airport (Lovington)
Land acquisition—clear zones both ends NE/SW runway; construct NW/SE runway 3000 ft. x 75 ft. and taxiway.

TOTAL **$652,375**

NEW YORK

Alexandria Bay **$31,500**
Towns of Alexandria, Clayton and Orleans
Thousand Islands Airport
Land acquisition for new site including clear zones; construct landing strip 3200 ft. x 250 ft.

Binghamton **140,000**
County of Broome
Broome County Airport
Addition to administration building; land acquisition—clear zones.

East Hampton **372,175**
Town of East Hampton
East Hampton Airport
Land acquisition—clear zones and relocation of roads; relocate transmission line; construct runway No. 7-25, 4500 ft. x 100 ft., taxiway, entrance road; install lighting; relocate road.

Elmira **180,000**
County of Chemung
Chemung County Airport
Extend apron; construct administration building.

Ithaca **115,000**
County of Tompkins
Tompkins County Airport
Strengthen NW/SE runway; widen and lengthen NW/SE runway to 5000 ft. x 150 ft., including lighting.

Jamestown **142,500**
City of Jamestown
Municipal Airport
Construct NE/SW taxiway; light taxiway; relocate portion of entrance road.

Massena **17,810**
Town of Massena
Richards Field
Construct addition to administration building.

New York **1,250,000**
The Port of New York Authority
Idlewild Internat'l. Airport
Construct parallel instrument runway No. 4R-22L (8500 ft. x 150 ft.).

New York **1,250,000**
The Port of New York Authority
LaGuardia Field
Airport rehabilitation—terminal area site preparation.

Olean **102,500**
City of Olean
Municipal Airport
Pave NE/SW runway 4700 ft. x 100 ft., taxiway and apron, entrance road and auto parking area; install runway lighting including beacon.

Poughkeepsie **22,500**
County of Dutchess
Dutchess County Airport
Land acquisition—runway extension and clear zones.

Schenectady **37,930**
County of Schenectady
Schenectady County Airport
Land for N/S clear zones (reimbursement).

Utica **318,000**
County of Oneida
Oneida County Airport
Expand administration building; construct auto parking area and sewage disposal plant; install taxiway and apron lighting; water supply system.

White Plains **121,330**
County of Westchester
Westchester County Airport
Construct taxiway; fencing; land acquisition—reimbursement.

TOTAL **$4,101,245**

NORTH CAROLINA

Asheville **$485,250**
City of Asheville
Municipal Airport
Land acquisition—clear zones and airport development; grade landing and terminal areas.

Charlotte **45,000**
City of Charlotte
Douglas Municipal Airport
Acquire land—clear zone; extend plane parking apron; reconstruct existing plane parking apron.

Fayetteville **38,000**
City of Fayetteville
Grannis Field
Strengthen existing E/W and NNE/SSW runways, taxiways and apron; clear zone easements—E/W and NNE/SSW runways.

Greensboro-High Point **172,615**
Greensboro-High Point Airport Authority
Greensboro-High Point Airport
Land acquisition—clear zones and aviation easements; grade additional apron, taxiway and parking areas; turfing; pave taxiway extension and auto parking area.

Lumberton **10,000**
City of Lumberton
Municipal Airport
Pave apron.

Raleigh-Durham **115,000**
Raleigh-Durham Airport Authority
Raleigh-Durham Airport
Reconstruct runway No. 5-23 and taxiway; land acquisition—clear zone.

Shelby **15,000**
City of Shelby
Municipal Airport
Construct administration building.

TOTAL **$880,865**

NORTH DAKOTA

Bismarck **$67,000**
City of Bismarck
Municipal Airport
Reconstruct runway.

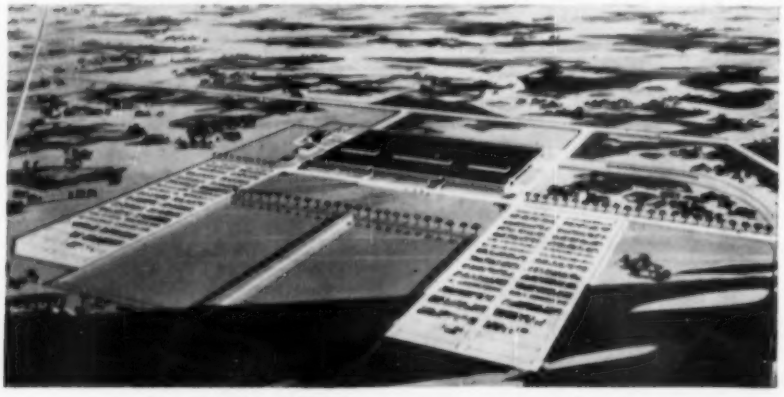
Fargo **35,000**
City of Fargo
Hector Municipal Airport
Pave apron; construct maintenance building for airport equipment.

TOTAL **$102,000**

OHIO

Akron-Canton **$89,000**
Summit County Commissioners
Akron-Canton Airport
Land acquisition—clear zones; construct entrance roads and auto parking area.

Cleveland **1,092,500**
City of Cleveland
Hopkins Airport
Construct and light extension



Pratt & Whitney Florida Plant

Architect's conception shows how P&W Aircraft's Florida operations will look outside of West Palm Beach. "Advanced engines for the next generation aircraft" will be manufactured in the Florida plant.

runway No. 9-27, 485 ft.; construct and light E/W parallel runway, 6000 ft. x 150 ft. and taxiway; construct connecting taxiway.

Cleveland **100,000**
City of Cleveland
Lakefront Airport
Construct administration building including roadways, drainage, etc.

Cleveland **310,000**
County of Cuyahoga
Cuyahoga County Airport
Land acquisition—clear zones and runway.

Columbus **800,000**
City of Columbus
Port Columbus
Secondary source of lighting; construct roads, car parking areas and utilities; complete apron; extend taxiway.

Dayton **500,000**
City of Dayton
James M. Cox Airport
Construct administration building, including entrance roads and auto parking area.

Port Clinton **10,500**
City of Port Clinton
Municipal Airport
Land acquisition—airport development.

TOTAL **$2,902,000**

OKLAHOMA

Fairview **$25,500**
City of Fairview
Municipal Airport
Land acquisition.

Hobart **39,000**
City of Hobart
Municipal Airport
Construct administration building and water line; install N/S runway lights 4100 ft.

Nowata **16,000**
City of Nowata
Municipal Airport
Land acquisition; construct N/S runway 2400 ft. x 50 ft.; fencing.

Oklahoma City **144,000**
City of Oklahoma City
Will Rogers Field
Strengthen taxiway, apron and N/S runway.

Okmulgee **20,000**
City of Okmulgee
Municipal Airport
Extend water line.

Pauls Valley **24,200**
City of Pauls Valley
Municipal Airport
Land acquisition—clear zones; install lights N/S runway; pave entrance road; extend water line.

Pawhuska **25,000**
City of Pawhuska
Municipal Airport
Pave N/S runway 3000 ft. x 50 ft.; construct taxiway and apron; install lighting.

Ponca City **41,500**
City of Ponca City
Municipal Airport
Construct taxiway.

Shawnee **6,000**
City of Shawnee
Municipal Airport
Install lights N/S runway.

Tulsa **500,000**
City of Tulsa
Municipal No. 1 Airport
Construct administration building.

Tulsa **85,000**
City of Tulsa
Municipal No. 2 Airport
Construct taxiway and apron; fencing.

Woodward **5,700**
City of Woodward
West Woodward Airfield
Install lights N/S runway.

Total **$934,900**

OREGON

Eugene **$137,402**
City of Eugene
Mahlon-Sweet Airport
Construct N/S taxiway and warm-up apron; construct addition to administration building, including entrance road, auto parking area, fencing and utilities.

Grants Pass **56,411**
County of Josephine
Grants Pass Airport
Land acquisition—airport development and clear zones; airport and approach clearance; construct landing strip 6000 ft. x 250 ft., taxistrip, apron, auto parking area; fencing; entrance road and utilities.

Medford **48,750**
City of Medford
Municipal Airport
Install high intensity runway lights.

Pendleton **10,356**
City of Pendleton
Pendleton Airport
Rehabilitate runway lights; install airport beacon; fencing.

Portland **821,557**
Port of Portland
Portland Internat'l. Airport
Install sewer and water supply system and electrical system; land acquisition—clear zones; construct and light taxiways and aprons; complete entrance road and auto parking area.

Total **$1,074,477**

PENNSYLVANIA

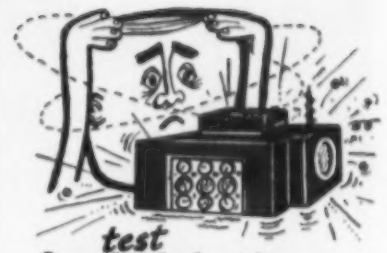
Allentown **$520,820**
Lehigh-Northampton
Airport Authority
Allentown-Bethlehem-
Easton Airport
Land acquisition—clear zone and runway extension; site preparation for primary runway extension; extend primary runway 860 ft. including overlay, taxiway and lighting.

Altoona **173,500**
Altoona-Blair County
Airport Authority
Blair County Airport
Land acquisition—clear zone primary and secondary runways; extend primary runway to 5500 ft.; resurface primary runway; construct taxiway to terminal area and entrance road; install field lighting.

Coatesville **15,000**
City of Coatesville
Municipal Airport
Land acquisition—clear zones and runway extension.

Erie **40,500**
City of Erie
Port Erie
Resurface runway No. 2-20; install lighted wind cone and segmented circle; land acquisition—airport development.

Harrisburg **97,000**
Commonwealth of



test
A ~~stitch~~ in time
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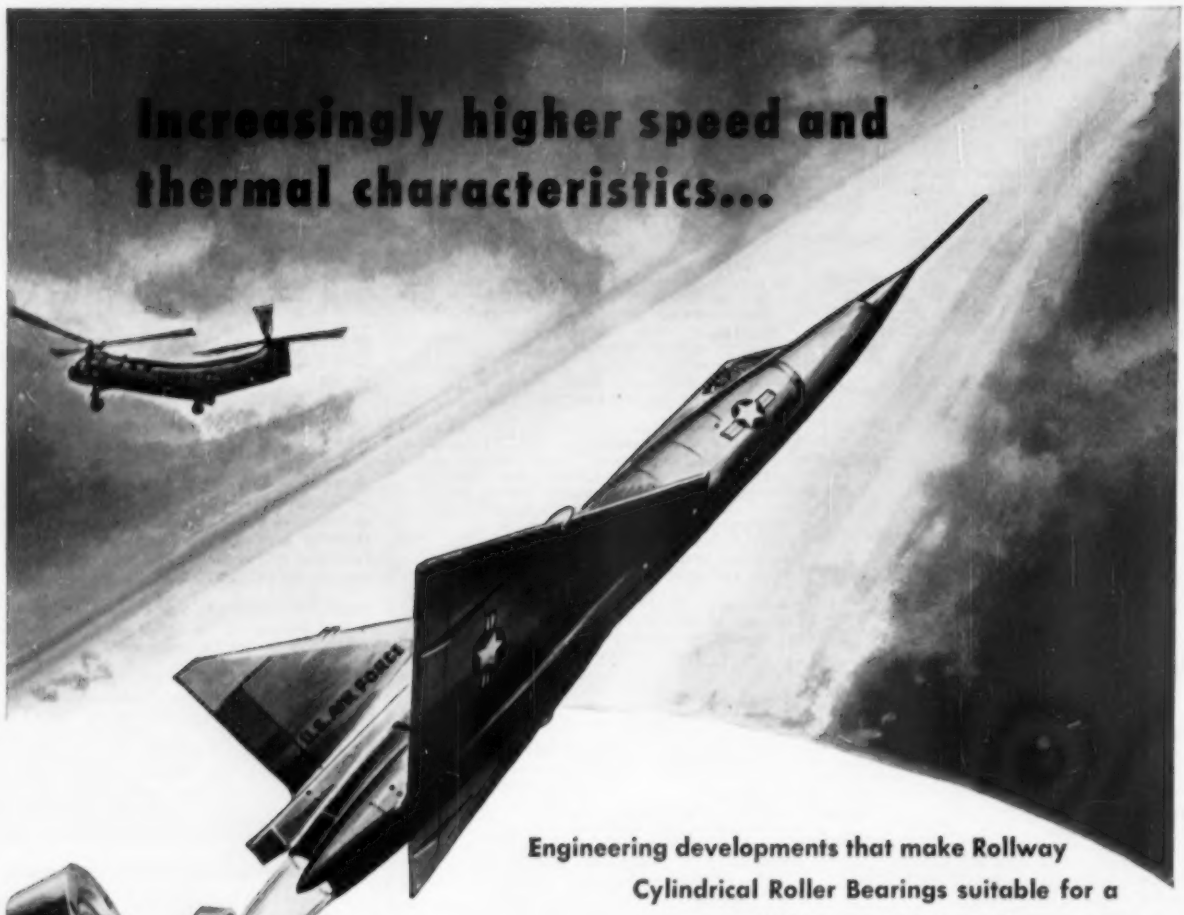
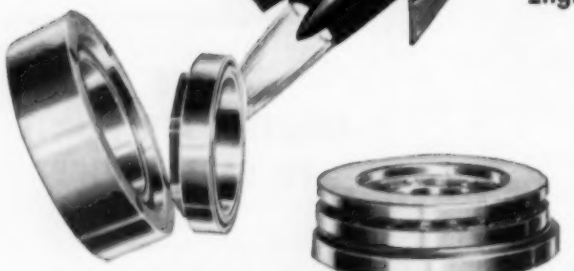
Increasingly higher speed and thermal characteristics...



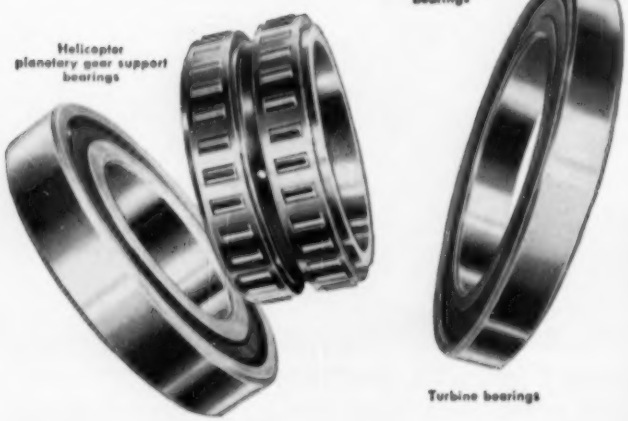
Engineering developments that make Rollway Cylindrical Roller Bearings suitable for a wide range of aircraft applications



Hydraulic control-system bearings

Helicopter rotor assembly thrust bearings

Helicopter planetary gear support bearings



Turbine bearings

Eight years after the Wright brothers' flights at Kittyhawk, Rollway began the production of cylindrical roller bearings. Careful inspection, metallographic checks, design evaluations and lubrication studies have steadily improved the range of performance as to speed, stress, ambient and operating temperatures.

Our key personnel are always ready to work on experimental or production models where high-stress, high-temperature, and high-precision bearings are essential.

Illustrated are a few of the Rollway Bearings produced for general aeronautics use. Not illustrated, for obvious reasons, are Rollway experimental bearings developed for test in various projects. A wire, letter or print will initiate a cooperative relationship that could be mutually rewarding. *Rollway Bearing Co., Inc., Syracuse, N. Y.*

ROLLWAY

BEARINGS

COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

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Pennsylvania
Harrisburg-State Airport
Construct administration building (second stage); install wind tee.

Indiana **80,000**
Borough of Indiana
Jimmy Stewart Airport
Land acquisition—clear zone primary runway; pave E/W runway 3000 ft. x 75 ft.

Johnstown **39,375**
Johnstown-Cambria County Airport Authority Inc.
Municipal Airport
Install taxiway and threshhold lights; fencing; enlarge administration building.

Latrobe **124,000**
Tri-City Airport Authority
Westmoreland-Latrobe Airport
Land acquisition—clear zones primary runway; site preparation for primary runway; pave primary runway 3700 ft. x 75 ft.

Meadville **58,400**
City of Meadville
Port Meadville
Land acquisition—clear zone primary runway; extend and resurface primary runway to 3500 ft., including lighting; resurface secondary runway.

New Castle **20,000**
City of New Castle
Airport Authority
New Castle Airport
Land acquisition—clear zones.

Philadelphia **225,000**
City of Philadelphia
North Philadelphia Airport
Land acquisition—clear zones.

Philadelphia **525,000**
City of Philadelphia
Philadelphia Internat'l. Airport
Construct maintenance building, garage and passenger loading pier.

Pittsburgh **1,250,000**
County of Allegheny
Greater Pittsburgh Airport
Site preparation for runway and taxiways.

Pottsville **224,113**
County of Schuylkill
Schuylkill County Airport
Complete site preparation; pave NW/SE runway 4600 ft. x 75 ft.; light NW/SE runway.

Reading **200,000**
Reading Airport Authority
Spaatz Field
Land acquisition—clear zones; construct taxiways and apron.

Waynesburg **185,000**
County of Greene
Greene County Airport
Land acquisition—clear zone primary runway; site preparation for primary runway; pave and light primary runway; pave apron and connecting taxiway.

Wilkes-Barre-Scranton **212,580**
County of Lackawanna and County of Luzerne
Wilkes-Barre-Scranton Airport
Land acquisition — entrance road; construct entrance road and auto parking areas; expand apron; administrative area fencing.

Williamsport **22,325**
Williamsport Municipal Airport Authority
Lycoming County Airport
Land acquisition—clear zone; approach zone clearing and lighting.

TOTAL **$4,002,613**

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By thus reproducing the conditions of an actual high-performance aircraft or missile in flight, the unit expands the capabilities of any laboratory.

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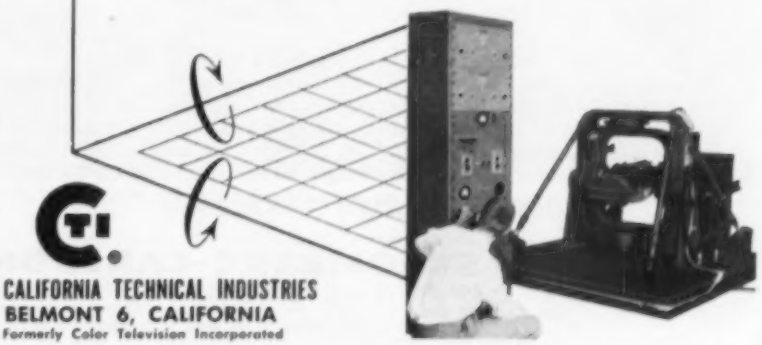

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For example, consider vacuum tubes, the heart of hundreds of projects in our Electronics Division. No spot check satisfies here (even if that's all our customer specifies)—but a whole series of critical tests, including such precise evaluations as these:

Inspection of tube characteristics to rigid Stromberg-Carlson specifications—performed on special equipment which can do in a half-hour what would take days on conventional testing devices.

Inspection by X-ray, looking for deeply hidden potential faults which could cause malfunction at any time after first use.

Inspection by microscope, seeking welding faults, minute cracks in glass, and even infinitesimal loose particles inside the tube.

And tubes are only one concern. *All* components must pass similarly rigid tests, to assure operating performance, ruggedness and reliability in the completed equipment.

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GD

RHODE ISLAND

Providence	**$317,500**
State of Rhode Island Theodore Francis Green State Airport Construct control tower, taxiways, apron, entrance roads and car parking areas.	
TOTAL	**$317,500**

SOUTH CAROLINA

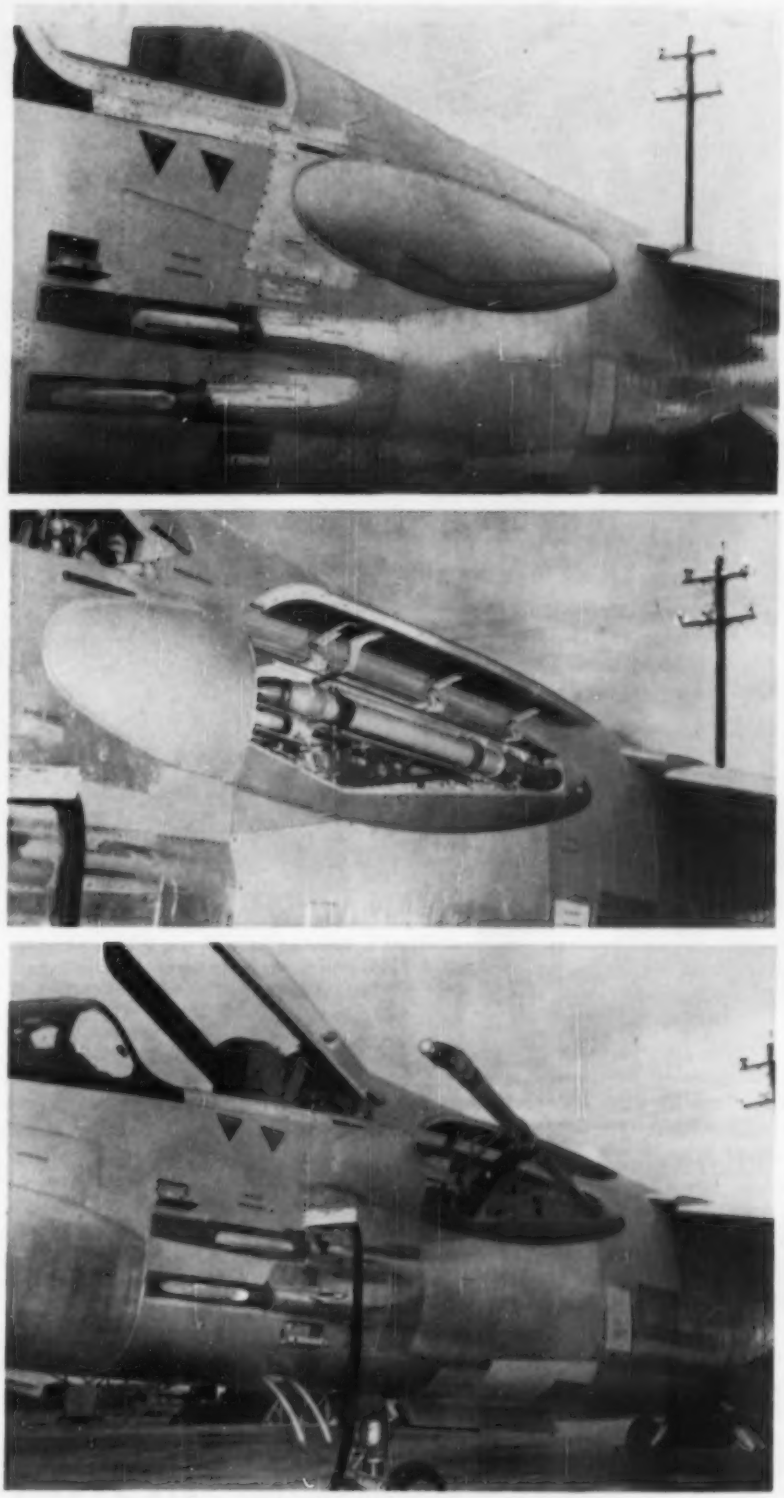
Florence	**$6,000**
City of Florence Municipal Airport Install medium intensity lights WNW/ESE runway.	
Greenville	**67,000**
Greenville Airport Commission Municipal Airport Land acquisition—clear zones N/S runway; strengthen N/S runway.	
Greenwood	**8,000**
Greenwood County Airport Commission Greenwood County Airport Acquire easements in west clear zone; reconstruct taxiway.	
Spartanburg	**68,500**
City of Spartanburg Memorial Airport Land acquisition—clear zones NE/SW runway.	
Sumter	**10,000**
City of Sumter Municipal Airport Construct administration building.	
TOTAL	**$159,500**

SOUTH DAKOTA

Mobridge	**$21,180**
City of Mobridge Municipal Airport Land acquisition—airport development and clear zones; construct NW/SE landing strip 2900 ft. x 300 ft. and entrance road; obstruction removal; fencing; install water and power supply.	
TOTAL	**$21,180**

TENNESSEE

Bristol	**$241,000**
Cities of Bristol, Johnson City and Kingsport, Counties of Washington and Sullivan Tri-City Airport Site preparation for runway and apron; pave southwest end of NE/SW runway 5000 ft. x 150 ft.	
Clarksville	**76,000**
County of Montgomery Outlaw Field Construct NW/SE runway 4000 ft. x 100 ft.	
Knoxville	**35,000**
City of Knoxville McGhee-Tyson Airport Install medium intensity lights NS runway and taxiway lights.	
Lexington	**44,000**
City of Lexington Franklin-Wilkins Airport Pave NW/SE runway 3600 ft. x 75 ft.; light runway extension.	
Memphis	**500,000**
City of Memphis Municipal Airport Land acquisition—airport development and clear zones.	
Milan	**45,100**
City of Milan	



Crusader's Refueling Probe

Here are three stages of operation of the inflight refueling probe of Chance Vought Aircraft's F8U-1 Crusader day fighter. Top picture shows inflight refueling installation on fuselage of Crusader in closed position. With housing door opened, center, refueling probe is shown in retracted position. When fully extended, bottom, nose of probe is opposite pilot's head so he can watch engagement with tanker's drogue.

Marquardt is Growing...

offering new opportunities to professional engineers

ROBERT L. EARLE, EXECUTIVE VICE PRESIDENT, *is second in command of the Marquardt engineering-production team. He is shown at Marquardt's new production plant now under construction at Ogden, Utah.*

Freedom to pioneer — freedom to grow . . . these are the challenges and new engineering opportunities at Marquardt Aircraft.

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Through these freedoms, Marquardt leads the way into advanced engineering projects.

These freedoms — pioneering and growth — are as individual as each professional engineer, as collective as the entire Marquardt team. Through them, Marquardt now offers new and unlimited opportunity for professional engineers in two of the West's most stimulating areas. At Ogden, Utah, in the heart of the Wasatch Mountain vacation area, Marquardt is now constructing a multi-million dollar production plant to produce supersonic powerplants for the Boeing Bomarc interceptor missile. And in Southern California's San Fernando Valley, Marquardt professional engineers are involved in a major expansion program for design, development, and test of new ramjet engines and turbojet and ramjet controls.

If you are a professional engineer interested in the freedom to pioneer — the freedom to grow — for yourself and your company, we invite you to investigate the opportunities at Marquardt Aircraft, today. Please contact Jim Dale, Professional Personnel, 16551 Saticoy Street, Van Nuys, Calif.

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Municipal Airport
Site preparation for landing strip 3700 ft. x 250 ft. and entrance roads; seed landing strip and clear zones; construct entrance road.

Morristown **8,000**
City of Morristown
Municipal Airport
Land acquisition—airport development; site preparation for NE/SW runway extension 700 ft.

Nashville **632,500**
City of Nashville
Berry Field
Construct parallel taxiway and bleed-offs; pave terminal apron.

Sevierville **25,000**
Cities of Sevierville and Gatlinburg
Sevierville-Gatlinburg Airport
Pave NW/SE runway 2900 ft. x 75 ft., taxiway and apron.

Union City **23,000**
County of Obion
Stewart Field
Resurface N/S runway, taxiway and ramp area.

TOTAL **$1,629,600**

TEXAS

Austin **$280,000**
City of Austin
Robert Mueller Airport
Construct administration building, entrance road, auto parking area and ramp.

Beaumont **246,205**
County of Jefferson
Jefferson County Airport
Install medium intensity lights runway No. 16-34 and taxiway lights; land acquisition—clear zones runway No. 16-34; fence; strengthen and mark runway No. 16-34.

Brownfield **94,625**
County of Terry
City-County Airport
Clear, grub, grade and drain NNE/SSW landing strip, taxiway and apron; pave NNE/SSW runway 3800 ft. x 75 ft., taxiway and apron; grade, drain and stabilize NW/SE runway; land acquisition—clear zone.

Brownwood **24,295**
City of Brownwood
Municipal Airport
Construct administration building, entrance road and car parking area; land acquisition—clear zones.

Cleburne **67,700**
City of Cleburne
Municipal Airport
Land acquisition—airport development; construct N/S runway 3500 ft. x 75 ft., entrance road and auto parking area; pave apron and taxiway; install lights on N/S runway; utilities.

Corpus Christi **575,888**
City of Corpus Christi
Municipal Airport (New)
Land reimbursement including clear zones; construct administration building, entrance road and auto parking area.

Decatur **20,600**
City of Decatur
Municipal Airport
Land acquisition—clear zones; construct N/S runway 2800 ft. x 75 ft.; install lighting.

El Paso **402,300**
City of El Paso
El Paso Internat'l. Airport
Expand administration building; resurface and strengthen instrument runway 6000 ft.; resurface existing and construct new taxiway.

Fort Worth **73,700**
City of Fort Worth
Meacham Field
Land acquisition—clear zones.

Galveston **8,855**
City of Galveston
Municipal Airport
Fencing.

Gonzales **35,000**
City of Gonzales
Municipal Airport
Land acquisition—clear zones; grading, paving and utilities.

Harlingen **146,697**
City of Harlingen
Municipal Airport
Drainage; leveling and grading N/S runway and taxiway; relocate drain ditch; pave N/S runway and taxiway; install lights N/S runway.

Houston **233,550**
City of Houston
Houston Internat'l. Airport
Land acquisition—clear zone; extend NE/SW runway 735 ft.; install taxiway lights; fencing; construct taxiway.

La Porte **27,000**
City of La Porte
Municipal Airport
Land acquisition—clear zone and airport development; construct NW/SE runway 3800 ft. x 75 ft.

Littlefield **30,000**
City of Littlefield
Municipal Airport
Land acquisition—airport development; site preparation; pave runway extension 1500 ft., and taxiway.

Longview **8,850**
County of Gregg
Gregg County Airport
Land acquisition—clear zones; obstruction removal.

Lubbock **80,620**
City of Lubbock
Municipal Airport
Expand administration building; construct taxiway.

McAllen **155,646**
City of McAllen
Miller Internat'l. Airport
Land acquisition—airport development; construct NW/SE runway extension 800 ft., taxiway and apron; install lights on runway extension and taxiway; construct administration building; extend canal siphon and drains; fencing.

Mineral Wells **99,150**
City of Mineral Wells
Municipal Airport
Land acquisition—clear zones; strengthen ends of runways and taxiways; construct taxiway and "T" hangar taxiways; drainage; pave entrance road.

Pecos **9,000**
Town of Pecos
Municipal Airport
Construct administration building.

San Antonio **591,552**
City of San Antonio
San Antonio Internat'l. Airport
Land acquisition—clear zones; extend and light runway No. 12-30 and taxiway; overlay runway No. 12-30 and taxiway.

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RESULT: Increased production, less operator fatigue, metal flows more readily, pools more evenly to produce cleaner, stronger welds — because all welding is done in the natural *downhand* position.

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Stephenville **46,500**
City of Stephenville
Municipal Airport (New)
Land acquisition—airport development; site preparation and grading of E/W landing strip; pave N/S runway 4200 ft. x 75 ft., stub taxiway and apron; install lights N/S runway; fencing.

Sulphur Springs **11,750**
City of Sulphur Springs
Sulphur Springs Airport
Land acquisition—clear zone and NW/SE runway extension; pave NW/SE runway 3700 ft. x 75 ft., apron and taxiways "A", "B", and "C", and entrance road.

Uvalde **15,000**
City of Uvalde
Garner Field
Strengthen runway, taxiway and apron; acquire clear zone easements.

Woodville **19,825**
City of Woodville
Municipal Airport
Land acquisition—clear zone and airport development; construct N/S landing strip 3000 ft. x 250 ft., and taxistrip; obstruction removal.

TOTAL **$3,304,308**

UTAH

Salt Lake City **$1,000,000**
City of Salt Lake City
Municipal No. 1 Airport
Construct administration building.

TOTAL **$1,000,000**

VERMONT

Brattleboro **$50,000**
Town of Brattleboro
Brattleboro Airport
Land acquisition—clear zone and airport development; construct turfed landing strip 2700 x 250 ft. and ramp.

Newport **35,000**
City of Newport
Newport Airport
Extend N/S runway 800 ft.

Rutland **12,500**
City of Rutland
McArthur Field
Resurface E/W runway.

TOTAL **$97,500**

VIRGINIA

Charlottesville **$50,000**
City of Charlottesville and County of Albermarle
Charlottesville-Albermarle Airport
Construct taxiways and expand apron; install taxiway lights.

Norfolk **42,500**
City of Norfolk
Municipal Airport
Land acquisition—clear zone.

Pulaski **234,041**
New River Valley
Airport Authority
New River Valley Airport
Land acquisition—clear zones and airport development; site preparation for primary runway 4000 ft. x 300 ft.

Roanoke **75,000**
City of Roanoke
Woodrum Field
Land acquisition—clear zone,

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Cincinnati, Ohio

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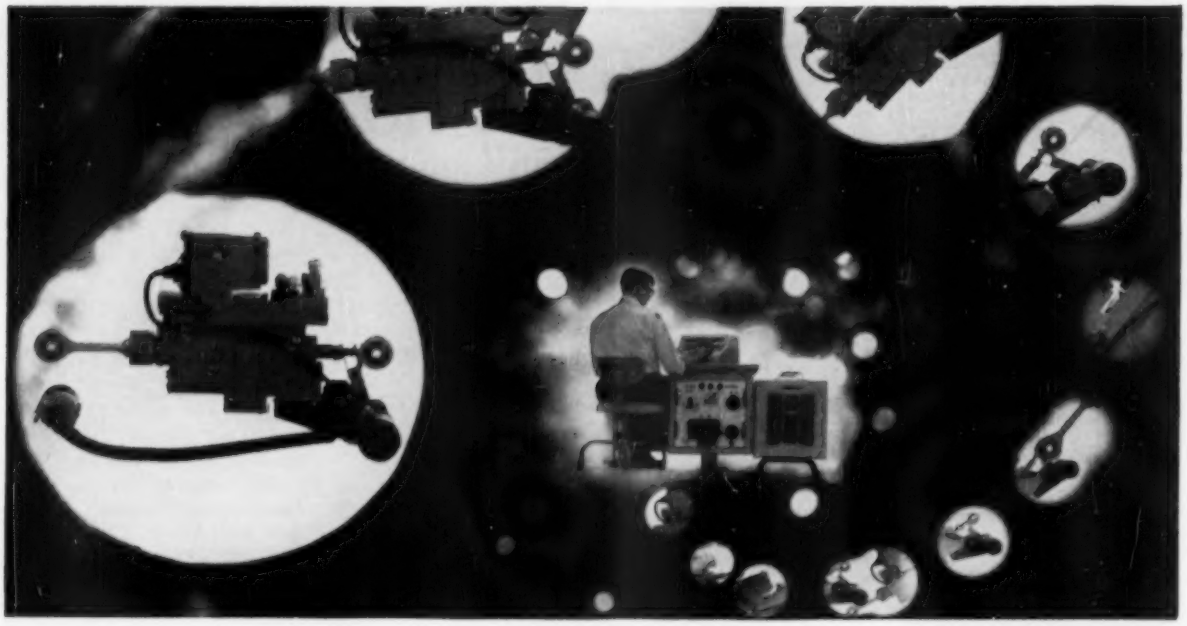
☐ BUSINESSMAN
☐ PROFESSIONAL MAN



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Dr. John Bower, former associate professor of electrical engineering at Yale, has been with Autonetics 7 years . . . 5 years in charge of automatic machine tool controls development. Last April he was promoted to automatic industrial controls section chief.

Leo Noe, MSEE-Yale, joined Autonetics in 1951 as research engineer in autopilots. In '53 he was promoted to supervisor. Leo's responsibilities included development of aircraft yaw and pitch dampers. In '56 he made group leader in automatic checkout.

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Degree (s) _____ Home Phone _____

Experience _____

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West Point 17,500
Town of West Point
Municipal Airport
Install runway lights.

Wytheville 200,000
Counties of Wythe and Smyth
Cities of Marion and Wytheville
Southwest Virginia Airport
Land acquisition—clear zones and airport development; clear approaches; site preparation for primary runway; construct entrance road and auto parking area; pave primary runway 3500 ft. x 75 ft., apron and connecting taxiway.

TOTAL $619,041

WASHINGTON

Bellingham $74,913
Bellingham Airport Commission
Municipal Airport
Reconstruct N/S runway and taxiway.

Connell 16,050
Town of Connell
Municipal Airport
Land acquisition—airport development and clear zones; construct E/W runway 2800 ft. x 75 ft. and taxistrip; fencing.

Ephrata 9,468
City of Ephrata
Municipal Airport
Install medium intensity lights on N/S runway.

Pullman-Moscow 11,896
City of Pullman, Washington and City of Moscow, Idaho
Pullman-Moscow Regional Airport
Land acquisition—clear zones primary runway.

Seattle 114,816
County of King
King County Airport (Boeing Field)
Complete reconstruction of primary runway 1700 ft. x 200 ft.

Seattle 847,242
Port of Seattle
Seattle-Tacoma Internat'l. Airport
Land acquisition—clear zones NE/SW runway; construct and light taxiway; construct crash and rescue station; enlarge administration building; reconstruct westerly portion E/W taxiway; fencing.

Spokane 26,320
City of Spokane
Felts Field
Pave taxiway.

Walla Walla 12,400
City of Walla Walla and County of Walla Walla
Walla Walla City-County Airport
Reconstruct loading ramp and taxiway "F".

Wenatchee 7,761
City of Wenatchee
Pangborn Field
Install medium intensity lights NW/SE runway; fencing.

Yakima 93,132
City of Yakima
Municipal Airport
Land acquisition — southeast clear zone; extend apron and ramp; install standby power unit.

TOTAL $1,213,998
Idaho portion of Pullman-Moscow project ..... —5,948
$1,208,050

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WEST VIRGINIA

Bluefield $88,750
County of Mercer
Princeton-Bluefield Airport
Extend and light NE/SW runway 250 ft. and taxiway.

Clarksburg 109,000
County of Harrison
Benedum Airport
Site preparation; pave taxiway and apron.

Huntington 325,000
Tri-State Airport Authority
Tri-State Airport
Construct and light taxiway; construct administration building, including utilities.

TOTAL $522,750

WISCONSIN

None

WYOMING

None

ALASKA

Akiak $60,000
Territory of Alaska
Akiak Airfield
Land acquisition—airport development; construct runway 2000 ft. x 100 ft. parking apron and entrance roads.

Allakaket 75,000
Territory of Alaska
Municipal Airport (Alatna)
Land acquisition—airport development; construct gravel surfaced runway 3600 ft. x 150 ft.

Crooked Creek 63,750
Territory of Alaska
Crooked Creek Airfield
Land acquisition—airport development; construct gravel surfaced runway 1800 ft. x 100 ft.

Dillingham 262,500
Territory of Alaska
Municipal Airport
Construct gravel surfaced runway 3750 ft. x 150 ft.

Haines 56,250
Territory of Alaska
Municipal Airport
Construct taxiway.

Hughes 112,500
Territory of Alaska
Municipal Airport
Land acquisition—airport development; construct gravel surfaced runway 4960 ft. x 150 ft.

Kaiskag 75,000
Territory of Alaska
Municipal Airport
Land acquisition—airport development; construct gravel surfaced runway 2500 ft. x 100 ft., entrance road and auto parking area.

Ketchekan 75,000
Territory of Alaska
Ketchekan S. Band Turnaround
Land acquisition—airport development; construct parking area.

Kobuk 37,500
Territory of Alaska
Kobuk Airfield
Land acquisition—airport development; gravel surface runway 2000 ft. x 100 ft., parking apron and entrance road.

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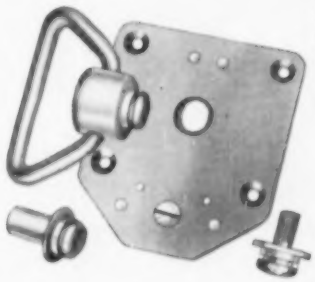

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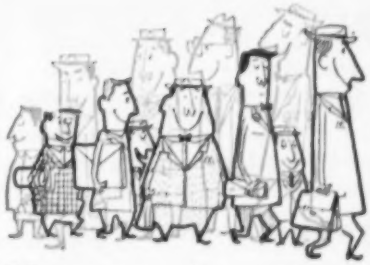

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Territory of Alaska
Ralph Wein Airport
Construct taxiway, parking apron and entrance road.

Napamute 71,250
Territory of Alaska
Napamute Airport
Land acquisition—airport development; construct runway 1800 ft x 100 ft., parking apron and entrance road.

Nondalton 37,500
Territory of Alaska
Nondalton Airport
Land acquisition—airport development; construct runway 2000 ft. x 100 ft. with parking apron and entrance road.

Port Graham 75,000
Territory of Alaska
Port Graham Airport
Land acquisition—airport development; construct runway 1600 ft. x 100 ft. with parking apron.

Seldovia 22,500
Territory of Alaska
Municipal Airport
Construct gravel surfaced runway 2000 ft. x 120 ft.; expand parking area.

Shaktolik 45,000
Territory of Alaska
Shaktolik Airport
Land acquisition—airport development; construct runway 1800 ft. x 100 ft., and obstruction removal.

Stony River 63,750
Territory of Alaska
Stony River Airfield
Land acquisition—airport development; construct runway 2500 ft. x 100 ft., parking apron and entrance road.

Teller 112,500
Territory of Alaska
Municipal Airport
Land acquisition—airport development; construct runway 2000 ft. x 100 ft., parking apron and road.

Wrangell 75,000
Territory of Alaska
Seaplane Ramp
Extend ramp and aircraft parking apron.

TOTAL $1,395,000

HAWAII

Honolulu $1,125,000
Hawaii Aeronautics Commission
Honolulu Internat'l. Airport
Construct first stage administration building; first stage of taxiways and aprons pavement.

TOTAL $1,125,000

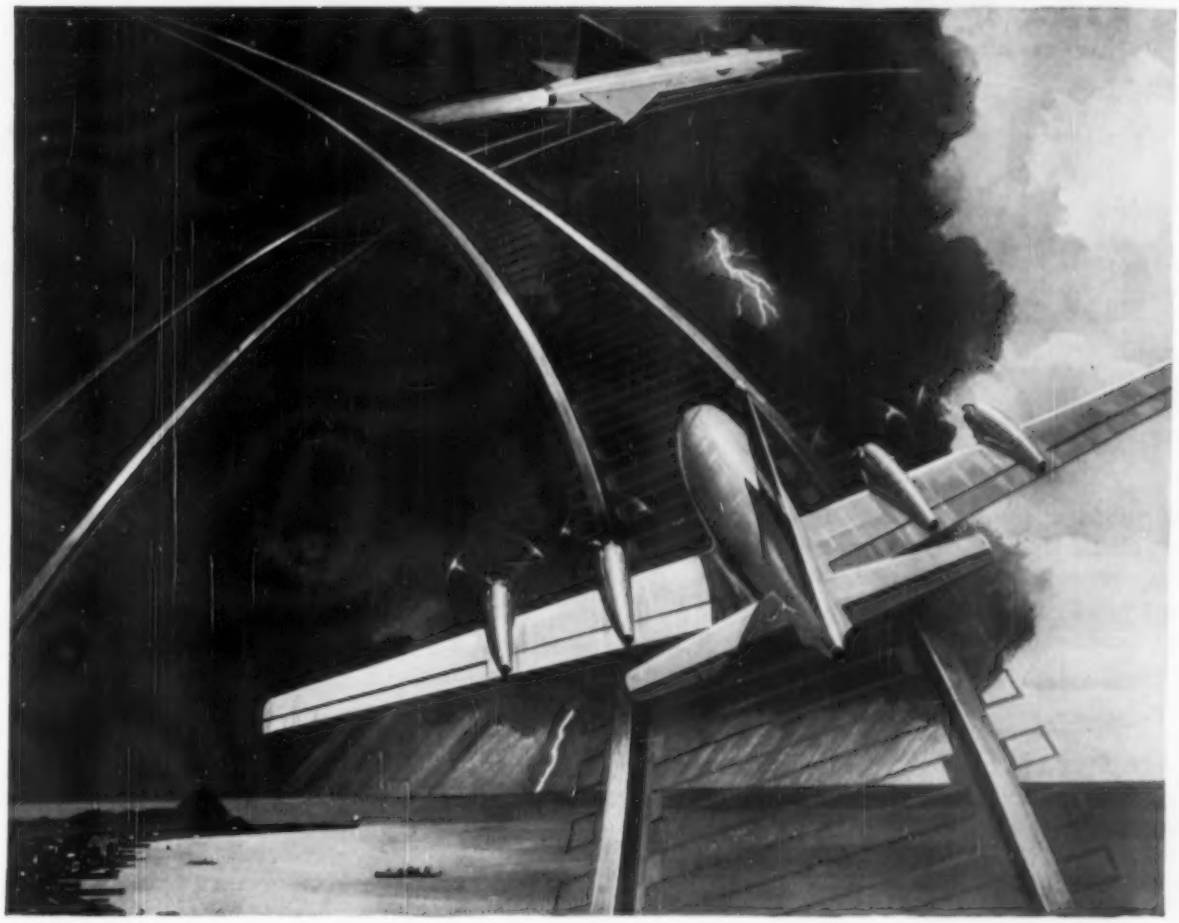
PUERTO RICO

San Juan $250,000
Puerto Rico Ports Authority
Puerto Rico Internat'l. Airport
Construct taxiways; extend terminal building and construct maintenance building.

TOTAL $250,000

VIRGIN ISLANDS

None



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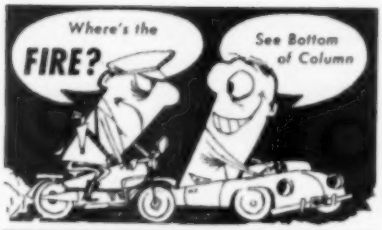

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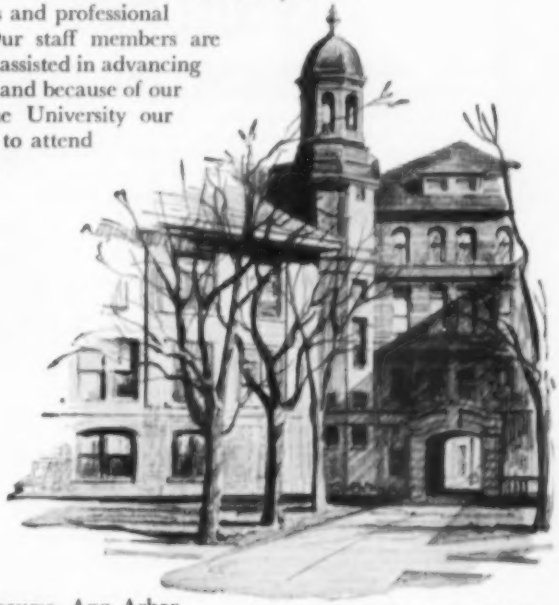

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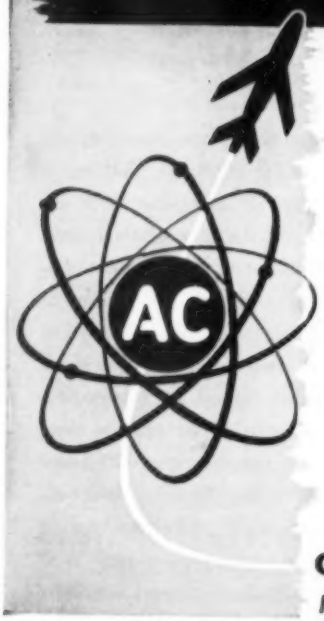

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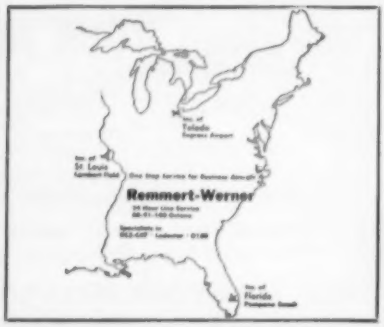

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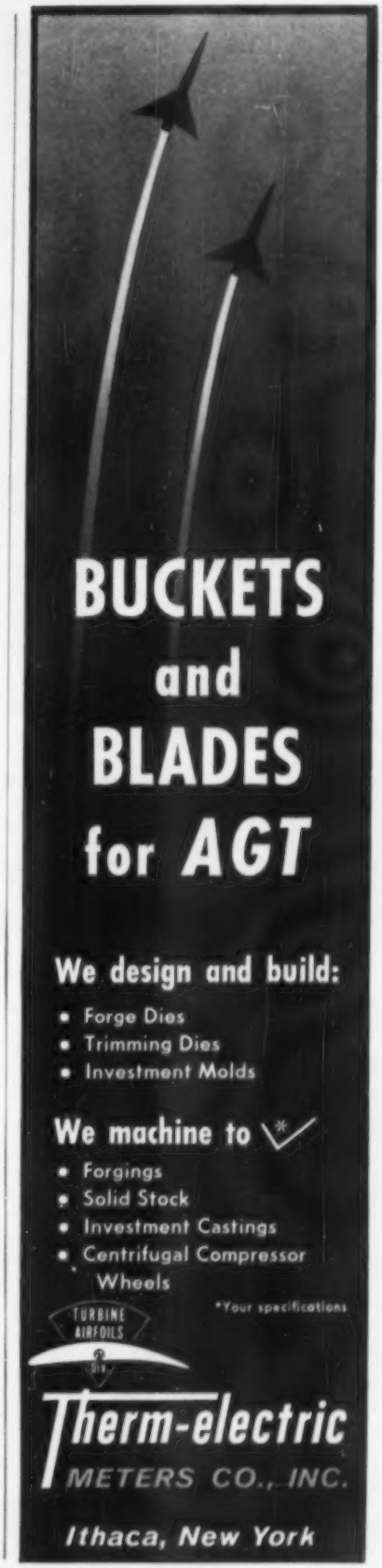


LETTERS

Free Lance Engineer

The letter titled "Ad Man Retorts," in the June 10 issue (p. 126), indicates that the letter from "A (Happy) Jobshopper," in the May 20 issue (p. 158), managed to rock the boat.

I do not agree 100% with this "jobshopper," but he did have a very interesting letter. As a former "jobshopper," I was disturbed by the Ad Man's seventh point about a "Jobshopper."

The engineer jobshopper is to the aircraft industry as the free lance writer is to journalism, or as the small contractor is to the construction business. They have traditionally been looked upon as the backbone of the American competitive free enterprise system. The jobshopper has no "womb to tomb security." He does a job for a company at an hourly rate and no sick leave, and when it is finished he must seek another job. There are no idle periods in his life when he draws a salary and waits for another contract or a design competition to be decided.

Many people, when considering jobshoppers, overlook the fact that almost all aircraft employes and all the top members of the Defense Department are essentially jobshoppers for the Defense Department.

LeRoy F. Iverson
Manhattan Beach, Calif.

Tu-104: Free Bomber?

In the wake of major USAF budget reductions and resultant cutbacks in airplane procurement programs, it is particularly disquieting to note the complacency of the western nations toward the apparent circumvention by the Soviet Union of the ruinous cost of a major bomber striking force.

In support of this viewpoint, attention is invited to the Tu-104. Regardless of explanations given for the various unconventional aspects of the airplane as a transport, the following features mark it as a formidable medium bomber:

1. High ground clearance.
2. Radome.
3. Bombardier's station in nose.
4. High subsonic speed.
5. Adequate range.

Neither transport nor bomber function has been greatly compromised when the external weapon carriage concept is used in conjunction with built-in aiming provisions.

Consider the Tu-104 in commercial operation. Contemporary news items tell of Soviet Union negotiations for air routes to various countries outside the iron curtain. Extrapolating, Soviet air crews may be seen legitimately guiding their jetliners to key destinations in many western countries on a competitive paying basis. Crews could be rotated for complete familiarization with the whole route system "in the interest of greatest efficiency."

Assume the above accomplished, then consider that the need for a Soviet TAC bomber force arises. Tu-104 jetliners with crews experienced in routes, objectives and equipment are "drafted." The airplanes are prepared by attaching suitable weapons beneath the fuselages and adding cabin fuel if required. By hurrying, the crew will have had time to change to their reserve air force uniforms, attend briefing and make ready the weapon directing equipment before takeoff time. It should be noted that for blind bombing the radar would be needed, but an optical sight is excellent for bombing objectives in countries favored by largely clear weather climates, especially one where weather reports are broadcast frequently.

In addition, the high reliability and readiness factors of the Norden type bombsight are advantageous.

Although the Tu-104 might not be quite as desirable in the medium bomber class as, perhaps, the B-47, the whole Tu-104 program, equipment, crews and maintenance could be paid for through internal Soviet commercial operation. Add the international routes and "on the job training" is provided the crews at the customer's expense.

This appears to be a potentially cost-free bomber force, a case of eating their cake and having it, too.

Are we missing something?

Charles H. McConnell
Seattle, Wash.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Handwriting in Air

Your recent articles and editorials concerning the problems of military airspace reservations are not in keeping with your excellent record and policy of service and unbiased information to the aviation world. Your editorial in the May 27 issue ("Are We Wasting Precious Airspace?") is a case in point.

Airspace reservations for the purpose of military flying training, testing and firing of missiles and nuclear weapons are not indiscriminate grabs for the purpose of causing inconvenience to other airspace users. Airspace reservations are designed to provide safety to all transient users, including the military. Certainly air carriers would not want to risk the safety of passengers and equipment by traversing areas in which missiles and fledgling pilots are earning their wings.

True, some savings in time and distance for commercial carriers could be realized if we did away with certain reservations. However, I do not believe that the public interest would be served if the Los Angeles-Phoenix schedule was cut from 1 hr. 55 min. to 1 hr. 45 min.

Civil aviation and the CAA are just beginning to realize what the full impact of jet carrier operations will mean as far as airways, air traffic control and airspace is concerned.

Military aviation has lived with jet flying problems for the past twelve years.

The total area of civil airways today almost completely covers the continental land areas of the U.S. as well as much over ocean area. This area is being further expanded to higher altitudes as a result of CAA's recognition of their responsibility to control altitudes in which jet aircraft must operate.

Up to the present time military aviation has operated in these upper areas without the assistance of CAA control, with the exception of limited advisory service.

The Grand Canyon episode was an inevitable climax to the attempt to "control" modern air traffic with a system designed for the DC-3 operating at maximum altitudes of 10,000 ft. and 150 mph. For many years, the Air Force has proposed the more extensive use of radar (both precision and long range) for air traffic control purposes. The CAA and parent organizations did not see fit to go along with the idea nor were sufficient funds appropriated until recent tragedies and the prospect of a jet air carrier fleet forced the air traffic controller to fold up his flight progress strips, ground speed computer and other long outdated "posting" methods and take a long hard look at a radar scope.

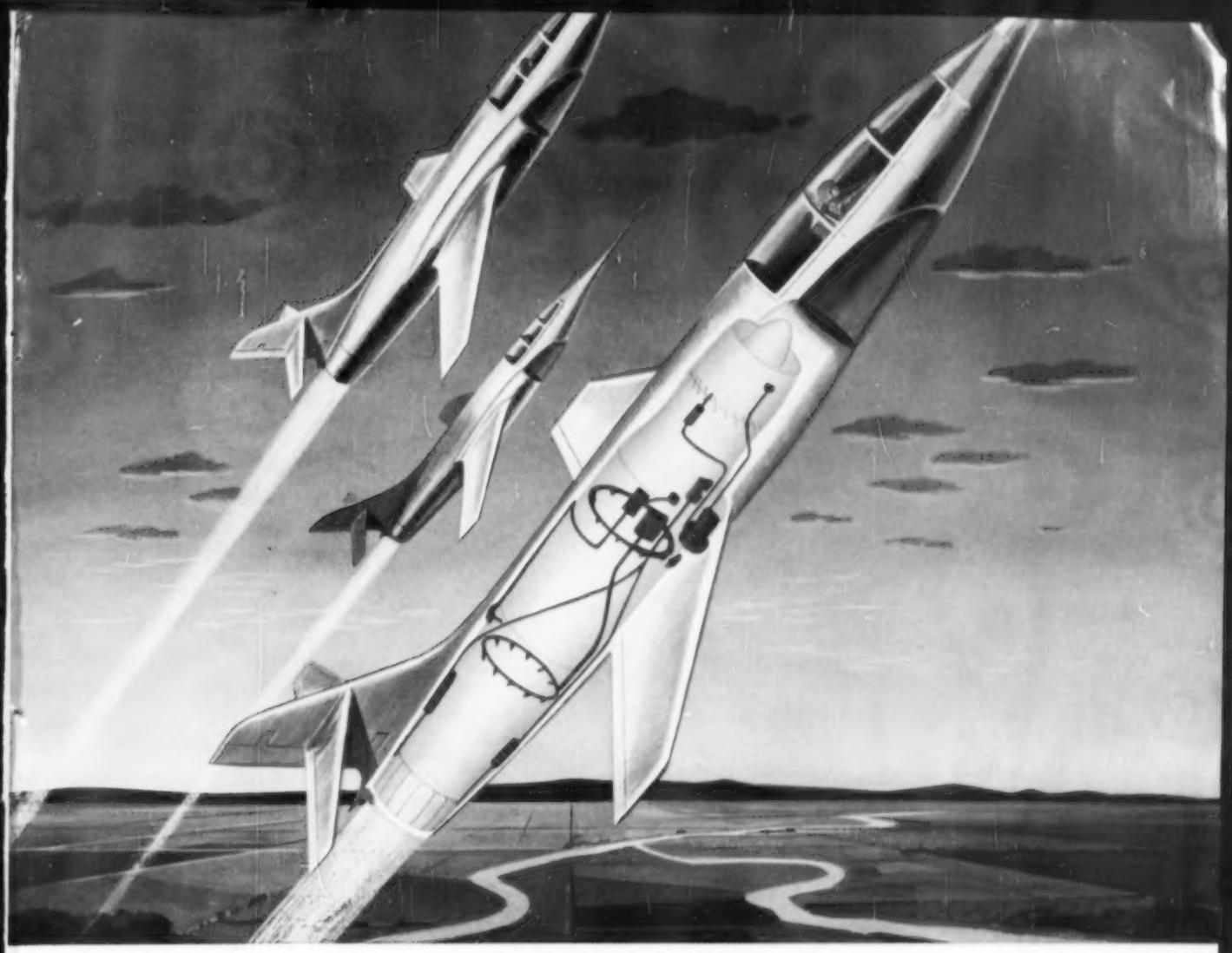
With radar, it is no longer possible to cut corners and radio in "fix" times that were not accurate. The controller could now actually "see" the aircraft under control as well as all aircraft in the vicinity. The aircraft could proceed from point A to point B without the need of designated airways and restricted approach channels. After decades of the "strip posting" method of air traffic control it was hard to accept the radar method. However, the handwriting was on the wall, or rather in the air, and it was written in jet contrails at 40,000 ft. at 600 knots.

The result was CAA's recent contract for long range radar.

True, radar has its troubles in precipitation, blind speeds, and interference. Radar is no better than the voice communications system needed to pass control instructions but radar is a big step forward for CAA which will greatly alleviate the airspace shortage which is caused not by military airspace reservations but because of the airspace needed to control air traffic with the present outmoded system based on time and altitude. The military has long advocated a joint military-civil policy for air traffic control. It is obvious that the information needed for air traffic control, air defense and interceptor operations is identical data and may be obtained from a common source at great savings in equipment, airspace and controllers.

Military aviation stands ready to lend full assistance to the civil air traffic controller and airspace user to insure the safer more expedient operation of one of our greatest assets—our Airpower.

August Mirzaoff
Washington, D. C.



TOWARD MACH 3

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